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Potrerillos townsite, about 10,000 ft. above sea, millsite in lower right corner. Canyon shown in middle foreground is 3,000 ft. deep. Mountains in vicinity 18,000 ft. high

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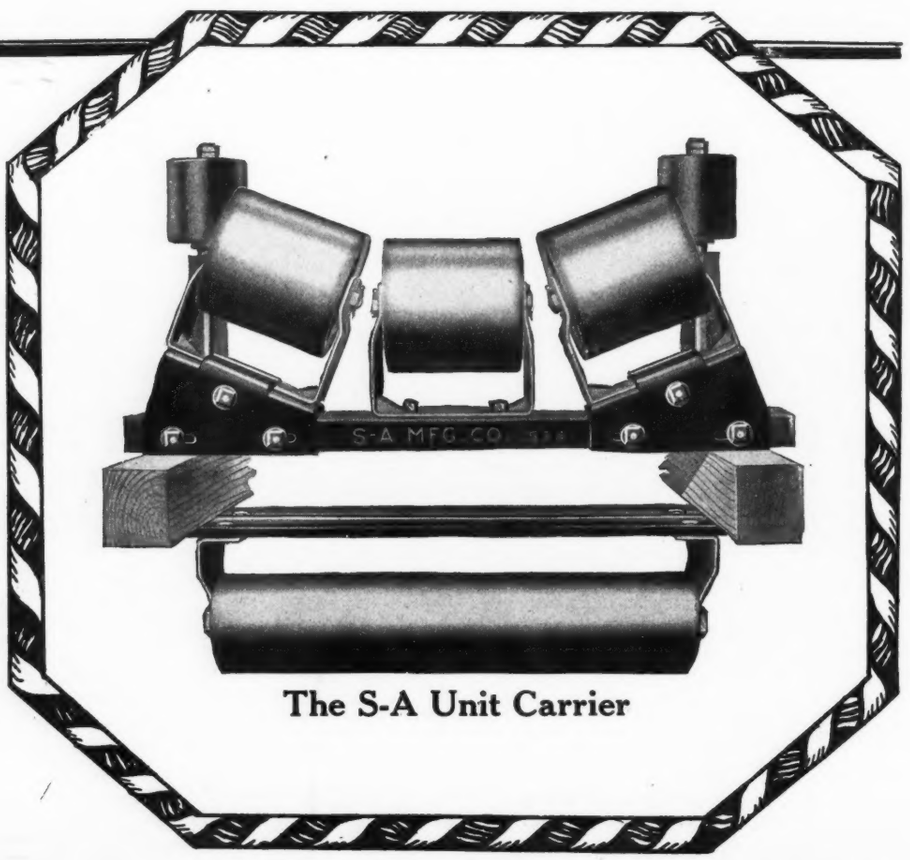

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries

METALS NON-METALS PETROLEUM

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J. VOLNEY LEWIS, Special Consulting Editors

Volume 109 New York, June 5, 1920 *Number* 23

The Mining Industry and the Bureau of Foreign and Domestic Commerce

IN OUR EDITORIAL of May 15 on the "Destiny of the Bureau of Mines," wherein we outlined the shadowy Department of Mines created during the war by the voluntary co-operation of the War Industries Board, the Bureau of Mines, and the Geological Survey, we did not exhaust the enumeration of the bureaus which contributed toward this unofficial organization. Nor will we try to exhaust it now; but a letter which we publish on our What Others Think page renders it timely to refer to the mining industry activities of the Bureau of Foreign and Domestic Commerce of the Department of Commerce. This active bureau employs a number of experts, who travel in foreign countries and report concerning various foreign industries, including the mining industries. For the latter work, mining engineers or geologists are employed—for example, Dr. J. Morgan Clements, a well-known geologist, has for several years had the Far East as his field, and toward the close of the war Mr. Courtenay De Kalb was sent to report on the mining industries of Spain. This field of the Bureau of Foreign and Domestic Commerce may overlap the work of the Bureau of Mines and the Geological Survey: for example, the two latter bureaus, working in co-operation, sent engineers to Spain in part to report on the Spanish potash deposits, at the same time that the Bureau of Foreign and Domestic Commerce sent a mining engineer in part for this same purpose.

Before the war, the mining bureaus of the Interior Department—the Geological Survey and the Bureau of Mines—were, like the rest of the United States, not fully awake to the necessity of studying the mining industries of foreign countries as well as those of the United States; but the war showed clearly that we cannot understand in the least our domestic mining industries without the background of world conditions; and considerable progress was made in both bureaus. Since the armistice this progress has slackened; but it is essential that it should continue, and that the foreign mining study of the Bureau of Foreign and Domestic Commerce should be arranged in co-operation with the mineral bureaus proper.

In the meantime, the Bureau of Foreign and Domestic Commerce is clearly in the wrong in denying its circulars concerning mining conditions to mining engineers, and furnishing them only to exporters. It is wrong on general principles. Either a thing is confidential within Government circles, or it is for public use. If for public use, it is wrong to furnish it to one class of citizens and deny it to another. The Geological Survey or the Bureau of Mines would not dream of making any such distinction, for which, in our opinion, no legal justification can be found. But even if such preferential information were proper, the class of Americans most interested in a matter like the western Manchurian copper deposits, reported by the geologist and engineer, Dr. Clements, is the mining industry itself.

The Unit of Cost-Keeping in Mines

IN THE Copper Range of Michigan, the mine and mill managers do not figure their copper in percentages. This is too crude a method for the conditions. Where a mine has ore running three-quarters of 1 per cent a ton, the ordinary mining man would not care to inquire further, but would turn down the proposition; but in the Lake Superior country, this not only interests operators, but they desire the value more in detail. Is it 15 lb. of copper to the ton, as the rough percentage stated would seem to indicate, or is it 14, or 16 lb.? It makes a big difference to them. After all, should not engineers—even mining engineers—be reasonably exact?

This focusing of attention on the pounds of copper in the crude ore—the same commodity that is marketed at the close of the mining and milling process—leads to cost-keeping on the same basis. The conventional method of cost-keeping in mines is on a unit basis of the ton of ore; and that does not satisfy the requirements of the Lake Superior people, who disregard this conventional unit, and follow out the costs of the pound of copper from the stope to the market.

In copper mines in general, the total relative value of great mines has come more and more to be expressed in the same way. One mine has as its cost of copper, 9c., another 11c., another 15c. per pound. The relation of the possible mine production to the price of copper can easily be followed. But in most of these mines, if we do not mistake, the mining and milling costs are still based on the ton of ore, which may contain 20 or 100 pounds of copper.

Is it feasible to substitute further the per-pound cost for the per-ton cost? We believe that it is. To be sure, in most mines, the grades vary: certain ores are rich, some low grade, others have to be avoided entirely; and it costs more per pound of copper to mine and mill in one class of ore than in another. But how easy to figure out and express these different costs as so much per pound, in different grades, using the per-ton cost of rock as a factor in the calculation! Block A of ore contains 60 lb. of copper to the ton: it will cost 12c. a pound to recover it. Let stoping begin! Block B contains 30 lb. to the ton: it will cost 25c. a pound to recover it. That is the reason, Gentlemen of the Board of Directors, why we are not mining Block B, which, as you have pointed out, contains 200,000 tons of "ore."

May not this plan be applied to other mines besides those of copper, and what would be the result of a tendency toward change of this sort in cost-keeping?

Managers have to make a good showing: low costs are almost as much of a feather in the cap as are dividends. Even high dividends are not satisfactory if costs also appear high in comparison with other mines. It shows bad management. Does it? Not at all; but it passes for an axiom. Very often a manager by increasing his per-ton cost may increase net profits; very often by lowering his per-ton cost he reduces net profits, but makes a record for good management. He may do the former by excluding waste and low-grade ore, reducing his tonnage; he may do the latter by running in ore which does not pay, together with his pay ore. Who has not in the course of his experience run across the manager who honestly believes that if he can mix a low-grade ore which would not pay, with a high grade ore, and so obtain an average fair pay value, he is increasing net profits? And there are more who do not believe it, but know that it brings down operating costs. Such deceptive (self-deceptive or otherwise) operations would not be possible if the units were of metal rather than ore. In 1918, such and such a mine produced so many ounces of gold or silver, or pounds of copper, at a cost of so much per ounce or pound: in 1919, the production was so much, at an increased cost of so much.

Careless stoping or shooting barren rock to the mill may reduce the cost per ton, but increases the cost per unit of metal, and decreases the net profit. Careful mining or sorting, excluding ore below pay, may increase the cost per ton, but will decrease the cost per unit of metal, and increase the net profits. A danger on this side may be discerned in the operator who will tend to "gut the mine" for the record of low costs per unit of metal: but there are certain automatic safety brakes against this tendency, in the inevitable striking down-curve of profits, their abrupt termination, and the end of the job.

A mine that is operated ruthlessly in this way, for a record low cost per unit of metal, will soon be like the shaft which the tenderfoot contracted to sink in the early days of Leadville. He came back in a couple of days, and reported that after having gotten down ten feet, "the hole had come to a p'int," and he could get no deeper.

Denver Chosen for Mining Convention

DENVER has been selected by the American Mining Congress for its next annual convention, to be held during the week of Nov. 15. This is a date which all interested in mining should set down in their notes. The meeting at St. Louis last year was a success from every point of view. The attendance, however, could have been better. The work that the organization is doing at Washington and elsewhere is of great importance to the industry, and those who are alive to their own interests will do well to give it attention.

Special conferences are to be held on the gold question and on the subjects of oil shale and uniform state mine taxation. There will be especial point in conducting these at Denver. The gold mines of Cripple Creek are face to face with the possibility of shutting down, owing to the unsatisfactory situation. Then again, Colorado is the center of interest as far as oil-shale development is concerned, and in the same month that the convention is to take place the voters of the state will have submitted to them a bill calling for an increase in mine taxation.

The gold question was considered at length at the last convention, and important recommendations were made. As a result, two bills have thus far been introduced at Washington, one by Representative McFadden and the other by Representative Fairfield, both providing for paying a premium on new gold produced. The former bill covers the gold production of the United States. The latter has wider application, covering gold produced by American citizens abroad as well. Thus the influence of the American Mining Congress is apparent.

There was one noticeable defect in the St. Louis convention, and that was in the manner of appointing the committee on resolutions. This committee was most important, for under the convention rules no resolution could come before the main body without first receiving its approval. The personnel of the committee, therefore, should have been scrutinized closely. The manner of appointment, however, was rather haphazard, and in some cases, perhaps, the members so chosen were not thoroughly representative of their state delegations. The results obtained by two committees, one appointed carelessly and the other with great care, may possibly be the same, but in the latter case the work done will at least merit the greater respect.

The Railroads and the Mining Industry

THAT the mining industries of the country are among the best customers of the railroads is well known. This condition has created a dependence upon the transportation systems which has been disclosed with particular force since the strike of the switchmen and firemen. Food and perishable freight are about all that is moving satisfactorily in the East; and ores, metals, and metal products are almost completely tied up in many sections of the country.

The Eastern refineries are compelled to submit to various degrees of curtailment, owing to shortage of raw material. Were they able to operate, they would in most cases have to stock a large proportion of their product. The larger mining companies of the country in general control their own railroads, and so are in a better position, particularly as the rate of production so far this year has in general been only a fraction of capacity. However, they have difficulty in getting needed supplies. The smaller mining companies must take what service the railroads give them.

Plainly, an improvement in railroad conditions is an essential to the prosperity of the mining industry. How can this be brought about?

First, the railroads are suffering from a shortage of equipment. To get more equipment requires money. Money can be obtained by increasing cash receipts, or by borrowing. To increase cash receipts under the present conditions, freight and passenger rates must be increased, and it is altogether likely and just that this will be done soon. Rates have not been raised in proportion to the cost of upkeep and operation. One reason for this fact is that a railroad rate is not changed frequently. The aim is to adjust rates to average conditions over a long period of time. As the present high prices are not expected to continue, the rates have not been made to accord with them. But the roads need money, and when the price level comes down the Interstate Commerce Commission can readjust the schedules.

Borrowing is difficult, as money is scarce. Formerly it was largely in the hands of capitalists who were glad to invest it in railroad bonds and stocks. Now, a comparatively large proportion of capital has passed into the hands of "the common people," who are spending it for long-deferred pleasures—for theaters and ball games, for phonographs and automobiles, for $15 shirts and $4 stockings, pure-thread silk and full-fashioned. They are not investing it; rather, they are cashing their investments. At the present rate of spending, it is unlikely that their supply of money will keep up indefinitely, but, while it does, a little missionary work might be done in an effort to divert some of this money into investments in railroad bonds.

In the second place, the railroads have an inadequate supply of labor. The recent strike was not responsible for the present tie-up, but it accentuated it and brought about the disruption in traffic sooner than it would have occurred otherwise. Railroad employees are leaving for better-paid positions in less essential industries. Other wages must come down or railroad wages must go up. The first we believe will come about, but slowly; meanwhile, the latter may need revision upward. The money to do this must come again from increased freight and passenger rates.

The ore producer must not therefore feel badly about increased freight rates. If the service he gets from the railroads will be improved thereby, he will benefit directly. If the transportation service of the country is bettered, he will benefit indirectly but no less surely.

Good Advice to the Zinc Producers

CHARLES M. SCHWAB told some truths in his recent address before the American Zinc Institute, which we hope will be taken to heart by the executives of the large zinc companies. The reason, according to Mr. Schwab, why appropriate financial rewards have been lacking to those engaged in the zinc business is that the industry is disorganized and co-operation does not exist among producers. He intimated that had the business been handled as has the manufacture of iron and steel, conditions would be much more to the satisfaction of all concerned.

In this Mr. Schwab is dead right. To begin with, there are too many small companies operating, with the accompanying high overhead and hand-to-hand conduct of their business. There are too many individual zinc smelters. More money could be made if some of them were combined under a more powerful and efficient management.

Then, too, the policy of secretiveness must be broken down. Free access must be given to one anothers' plants, so that the best practice may be developed. This is a lesson the copper industry has learned and that the lead industry is rapidly learning. We know of one case where a zinc metallurgist was commissioned to find out just how a certain process was being conducted in another plant, but on no account to make public something which the staff at his own works had just discovered and which was considered quite a scoop. On inspecting Plant B he found that those operating it had been developing for three years the idea that had only just sprouted in the minds of his collaborators back home, and that it was nothing new.

At the recent meeting of the A. I. M. E. in New York, many zinc metallurgists from a certain large producer were present. Some or all had been instructed not to breathe a word about the work that they were doing, but to pick up every scrap of information from the other fellow. As to the ethics of this policy we will not refer. From the standpoint of business, it is antiquated.

Possibly, the recently organized American Zinc Institute will help matters. Its members have learned to talk zinc instead of spelter, and they may be able to nurture a policy of brotherly love in their treatment of one another.

Carbon Monoxide Investigations

IN THE March number of the "Reports of Investigations" of the U. S. Bureau of Mines, A. C. Fieldner gives a brief description of the work of the Bureau in investigating the proportions of carbon monoxide gas in the exhaust from automobile and auto-truck engines under operating conditions. The larger motive of the investigation is to determine the practicability of vehicular tunnels, several of which have been proposed recently. At Pittsburgh, a vehicular tunnel 5,700 ft. long is under construction. The results of the research will be of considerable interest to the mining industry, both on account of the establishment of standards of dilution of monoxide in air and because of the fact that more careful adjustments of engines will lead to marked fuel economies in operation.

Mr. Fieldner says that, at present, authorities differ in their opinions in respect to the allowable percentages of carbon monoxide in air. Practically all agree that 1 to 3 parts per 10,000 are safe. A few state that even 5 or 6 parts per 10,000 may be safely tolerated. The definite determination of this factor is under investigation by Dr. Yandell Henderson, of the Bureau, at the physiological laboratories of Yale Medical School, New Haven, Conn.

The extensive use of automobiles, auto trucks, and internal-combustion locomotives for surface transportation in the mining industry makes their safe and economical operation an important consideration. The need for vehicular tunnels has reopened again the question of the safe use of internal-combustion engines in places where ventilation is restricted within certain limits. We do not feel that this investigation should stop with a mere determination of certain limits of dilution, however valuable and useful they may be; rather, it should be pushed far enough to work out practical methods for the elimination of carbon monoxide from the exhaust. It is not known whether such an attainment is practicable, but it is a goal important in itself.

A Correction

IN OUR ISSUE of Jan. 24 we published an article by a South African correspondent containing the description of the New Modderfontein Gold Mining Co.'s mill on the Rand, and stated that the article was written exclusively for *Engineering and Mining Journal.* This was our understanding, but the Metallurgical Department of the Rand Mines, Ltd., of Johannesburg, has called our attention to the fact that this article was abstracted and in part copied from a pamphlet published on the occasion of the visit of the South African Technical Societies to the New Modderfontein mine on Jan. 18, 1919.

We regret that this error should have occurred.

WHAT OTHERS THINK

Mining Engineers Need Not Apply

In the *Engineering and Mining Journal* of May 8 I found a notice of the Clements report on western Manchurian copper deposits, recently published by the Bureau of Foreign and Domestic Commerce at Washington, D. C. Always interested in new copper developments, and being an old friend of the author of this report, I addressed a request for a copy to the Bureau mentioned, in accordance with your suggestion.

I have failed to receive a copy of the report, but I have been favored with two letters in reply, from the Bureau in Washington and from its local branch office, which explain themselves and which I attach herewith.

I am unable to appreciate the wisdom of an arrangement that bars a technical report of that kind from the members of the mining engineering profession and reserves it for exclusive circulation among "American firms conducting an export business," but far be it from me to criticize, and I write you this merely that other bona-fide inquirers may be saved the trouble.

New York City, N. Y. OLOF WENSTROM.

Form No. 438.

DEPARTMENT OF COMMERCE
BUREAU OF FOREIGN AND DOMESTIC COMMERCE
WASHINGTON

May 14, 1920.

Mr. Olof Wenstrom,
35 Congress St.,
Boston, Mass.

Dear Sir: Your recent inquiry has been referred to our district office in your city, in order that our representative may explain the manner in which we may be able to assist you.

Very truly yours,

R. H. BRASEL,
Division of Trade Information.

DEPARTMENT OF COMMERCE
BUREAU OF FOREIGN AND DOMESTIC COMMERCE
BOSTON DISTRICT OFFICE, 1801 CUSTOMHOUSE

Boston, May 18, 1920.

Mr. Olof Wenstrom,
35 Congress St.,
Boston, Mass.

Dear Sir: Receipt is acknowledged of your communication of May 10, which has been referred to us by our Washington office.

In reply thereto we would advise that the information you desire, contained in Confidential Circular F. E. 130, concerning copper deposits in Manchuria, is furnished only to such concerns as are registered on our "Exporters' Index," this Index comprising the names of American firms conducting an export business. We regret, therefore, that we cannot be of assistance to you in this instance.

Very truly yours,

F. A. GREENE,
For District Office Manager.

Systematic Prospecting

The importance of systematic prospecting to the mining industry, in my opinion, warrants further publicity and discussion. The recent article in the *Engineering and Mining Journal* on "Systematic Prospecting," by W. H. Grant, proposes a system that might win in a few cases. The difficulty with the proposed system will be to find a mining geologist of the kind described. But few have had the requisite experience in the examination of prospects or in the discovery of new veins. Their experience has been more in developed mines, picking up faulted veins, erratic orebodies, in ore deposition, and in apex litigation.

It matters little, however, whether the work is done by a mining geologist, a mining engineer, or a practical miner. In any case, the man at the head of operations, in order to be successful, must have had a large field experience in many districts and formations.

Mr. Grant states that the exploration companies find about one mine in four hundred properties brought to their attention. Does this not show something wrong with their system? Out of this four hundred, of which some mining engineer examines the reports in his office and rejects more than 95 per cent, it would be instructive to have 20 per cent of those turned down selected and have an actual examination made by an experienced man. My thought is that he would find several worthy of further development, and perhaps ultimately several good mines would be secured.

Many times reports may describe favorable geological conditions, or the development work may not have been properly done. The ore shoot perhaps has been lost on its rake, in which case a man of experience would recommend further development. As a matter of fact, I believe that more dividend mines are to be found in the United States among the present known veins than will be developed from among those that are unknown. There are valid reasons for this belief. Many veins are lean near the surface and do not warrant an owner of limited means in undertaking to explore at depth. As examples, the United Verde and United Verde Extension, at Jerome, Ariz., and the Granite Mountain, at Phillipsburg, Mont., may be mentioned. The copper veins at Butte will rarely assay 1 per cent copper in the first 100 ft. of depth. Marcus Daly, in working the silver veins of the camp, crosscut at 300 ft. depth and discovered the copper ore of the district.

The La Bufa mine, in Sonora, Mexico, was without merit near the surface. Two Mexicans went broke on it. Dave Richardson's brothers quit him, before his perseverance won out. The new silver camp of Arrowhead, 126 miles southwest of Ely, Nev., is proving of worth at depth. Years ago, when the camp of Revelle, six miles south, was producing, two shafts were sunk at Arrowhead, about 75 ft. deep, on barren white quartz veins in the rhyolite, and were abandoned. Peter Fox, a practical miner, two years ago, during the Tonopah-Divide excitement, made $4,000, and had faith enough to put it into one of the old shafts. Both of the old holes have developed commercial ores in the sulphide zone.

The practical man's "nerve," "faith," or "hunch" in something where he has known or seen similar conditions will sometimes win where a mining engineer might hesitate. Tonopah-Divide will apparently make good to the extent of a few mines, though neglected for twenty years. Brougher's perseverance, even after Wingfield quit, has won out.

Mining is a speculation, and no one should follow the mining business unless he is willing to take chances.

Even "wild-catting" has proved up new mines, in some instances. The Esperanza (Hopes) mine, at El Oro, Mexico, which for seven years was the largest dividend paying gold mine in the world, was located and proved up by a tenderfoot, a Frenchman. He believed that the Dos Estrellas gold vein should extend through the mountain to the other side. No one had ever been able to find any evidence of it, or float, or would even locate it.

The extension of the Promatory and Quinteria mines, seven miles west of Alamos, Sonora, Mexico, was found in a similar manner, by another Frenchman. There the vein was found to have been covered by a later eruptive flow.

Many valuable mines have been found by accident, though it was scarcely an accident that prompted Neil to tackle the Premier mine, in British Columbia. A well-known mining engineer had expended $60,000 in development. He had drifted alongside of the vein for 252 ft., but never crosscut it. At the breast, in the upper right-hand corner, a change occurred. He took a small piece for assay and obtained a return of 50c., and quit. Neil, at the same place, took a large general sample, which assayed $8.50. He crosscut the vein, which gave an average of $57 per ton, 60 per cent being silver.

In most of the mining districts of the United States the veins that are exposed above the surface have already been discovered. In my opinion most of the producing mines of the future in the United States will be found from further development of the most promising of these. Some new veins will be found by close prospecting, especially where they are softer than the adjoining country rock, and consequently covered. Veins of this character will only be found by following up the float to its source and trenching to bedrock. The old-time prospector will prove more adept at this than a mining geologist, because of the former's experience.

I recall but one well-known instance of a mining geologist being successful in the finding of profitable mines (not in the sense of new veins). That is the present editor of the *Engineering and Mining Journal*. With his assistants he spent several hundred thousand dollars, and acquired several good mines, one being a prospect. He did not find them by sitting in an office reading reports, but in the field in the examination of mines and prospects on which some development had been done. When a promising one was found upon which favorable terms could be obtained, work was done. I think that this is the best method of finding new mines today.

Secure the services (copartnership is better) of a man of large field experience, of mature years and judgment, whether a mining engineer, a geologist, or a practical man with some training and study. Let him pick his assistants, examine prospects and partially developed mines, and when, in his judgment, one warrants it, develop further. When it fails to show results, quit it and find another. This procedure will be found far cheaper than the present methods of some large companies, with their staff of engineers and office force, who examine not over 3 per cent of the properties presented.

Work and plenty of it is the only solution if new mines are to be found.

Denver, Col. G. L. SHELDON.

Is the Piston Drill Passing?

We do not know how the early miners first discovered how to drill holes in rock. Probably the first holes drilled or cut into solid rock were made by pounding a rock against the surface in which it was desired to make a hole or depression for the purpose of serving as a receptacle in which to grind corn. As the Greeks, Romans, and Egyptians were expert stone masons, we may readily presume that they were familiar with the hammer-and-drill method of cutting holes in rock.

The early Freiber miners chipped and cut the stone faces of their drifts or else cracked the rock by alternately heating and quenching it with water. The use of explosives in mining necessitated drilling holes in rock, and hand methods involving the use of the hand-held drill and hammer were quickly evolved in what are known as single-, double- and triple-handed methods of drilling.

The churn-drill method, in which a heavy steel bar with cutting edge was raised and allowed to fall repeatedly, was also developed. Rotary methods patterned after the wood auger were devised and used for drilling in softer rocks. All of these processes have survived and will continue to be used where they are appropriate and efficacious.

The development of mechanical substitutes for hand power really marked the beginning of modern mining. Early rock drills like the Burleigh followed the lines of the churn drill. The coal drills followed the auger type, although the cutting bit employed took on a much different pattern from that of the common wood auger bit.

Many makes of piston drills eventually came upon the machinery market and were successfully used in mining. We remember an early type of Rand drill which required several men to lift it. From this excessively heavy and clumsy type the materials entering into the construction of the drill and its design were so improved that two men could readily handle it.

The next step in the evolution of the rock drill was to reduce its weight so that it could be handled by one man. This was done by increasing the air pressure and reducing the size of the drill. Better materials also became available, resulting in an all-round drilling machine that at the time appeared to answer all purposes.

But the mining industry was not satisfied, nor were inventors either, and the water-Leyner drill next appeared. This type of drill made use of the hammer-and-drill principle and employed hollow steel. As usual with devices of this kind, it had to be perfected through actual use. The principle of its operation was a sound one, and its superiority over the piston type was demonstrated in many ways, but chiefly in light weight, faster drilling, and lower actual costs.

The mining industry is intensely conservative. It took a considerable time to introduce and establish the piston type of rock drill, but a relatively shorter time was required for the acceptance of the hammer type of drill. Modern drills of this type leave little to be desired. For the usual run of drilling work found in underground mines there is a size and type of hammer drill for every reasonable kind of work. Has the piston drill been displaced to the extent that in the course of a few years it will practically disappear?

It would be a matter of regret to the older miners who have played a part in the industry for the last two decades to see the piston drill go into the discard.

New York City, N. Y. OLD TIMER.

Standardization of Hose Fittings for Hammer Rock Drills

Lack of Interchangeability of Parts of Ordinary Type of Hose Couplings Annoying to Drill Users—Conical Joint, Standard Pipe Threads, and Use Of Heat-Treated Steel Suggested

BY GEORGE H. GILMAN
Written for *Engineering and Mining Journal*

SINCE the hammer rock drill has come into general favor, the users of such machinery have emphasized the need of the adoption of a uniform system of standardization by the various manufacturers. The desirability of this requires no comment. There are some whose enthusiasm prompts them to make the whispered suggestion of a standard drill of universal application to all conditions, but to the man having practical experience in drill manufacture this is obviously as impracticable as, for example, would be the adoption of a standard suit of clothes for all countries and seasons. Nevertheless, many parts of this type of drill and its accessories lend themselves to standardization, and this has been practiced to some extent by manufacturers who have employed the early features of the drill in the development of their product. This is exemplified by the partial standardization of the trunnions used to secure the drill to a mine column or tripod, of drill-steel shanks, and of sizes of air and water hose.

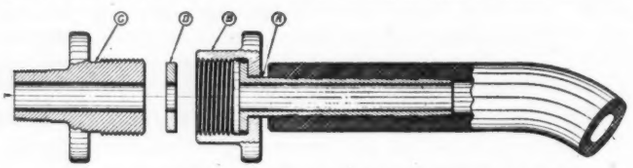
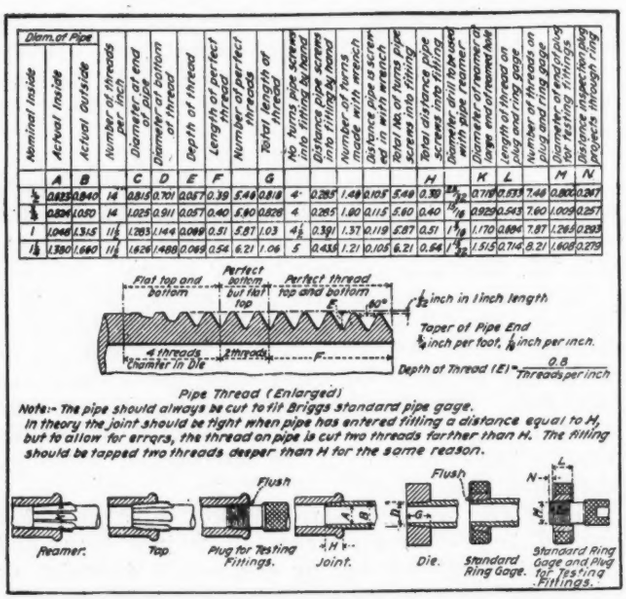


FIG. 1. GENERAL TYPE OF HOSE FITTING FOR ROCK DRILLS

Strange to say, this standardization has never been extended to hose fittings. There may have been a time in the dark ages of the industry when some manufacturers, to promote or insure to themselves the purchase of repair parts, made hose couplings according to an arbitrary specification, but such practice, we may safely assume, has long ago been abandoned by the reputable manufacturer of today. The most plausible explanation of the existence of the multitude of varieties of hose fittings on the market may be attributed to the laudable desire of different manufacturers to demonstrate to the trade the superiority of their individual products; and, as far as hose couplings go, many of these are of perhaps equal merit, although with respect to the resulting lack of interchangeability of parts, a distinct hardship is imposed on the user. This article is written with the hope that an observer, who has had the opportunity of witnessing the despair of the mine superintendent who tried to fit the Jones Manufacturing Company's union nut to the Brown Manufacturing Company's spud, may be able to offer some further practical suggestions that will tend to alleviate these evils.

Beginning with the Burleigh drill as employed on the Hoosac Tunnel, the usually accepted hose fitting for rock drills has been similar in all substantial respects to that shown in Fig. 1. As may be readily determined from an inspection of this figure, such a fitting includes the flanged hose nipple *A*, union nut *B*, which is internally threaded to receive the end of the spud *C*, and the gasket *D* interposed between the adjacent faces of the nipple and spud. As illustrated, the spud has formed on the end opposite the union nut an external pipe thread by means of which it may be secured to a pipe fitting, but when it is desired to connect it to the threaded end of a wrought-iron pipe the spud is formed with an internal thread.

The fitting illustrated, which it must be admitted possesses many advantages, for it has stood the test of time, has an inherent weakness, which resides in the gasket. This member has been the source of a great deal of trouble, due to its tendency to become lost when the air hose is detached for the purpose of supplying air for sludging the drill hole or for clearing the drift of powder fumes. In addition to this troublesome feature, the fitting possesses another evil not so easily guarded against. Professor Walter Weeks, in his interesting report published in the Oct. 6, 1917, issue of the *Mining and Scientific Press*, has shown that, if the hole in the gasket is not cut perfectly square, round, and of a dimension corresponding to that of the air passages in the fitting, there results a material loss in efficiency from friction of the air passing through the irregular or restricted opening. This defect cannot be eliminated as easily as it might appear from a hasty consideration of the problem, because the same conditions referred to by Professor Weeks frequently result from the distortion of the gasket through screwing up the union nut.


Flat top and bottom
Perfect bottom but flat top
Perfect thread top and bottom
60°
1/16 inch in 1 inch length
Taper of Pipe End
3/4 inch per foot, 1/16 inch per inch.
4 threads
Chamfer in Die
3 threads
F
Depth of Thread (E) = 0.8 / Threads per inch
Pipe Thread (Enlarged)
Note:- The pipe should always be cut to fit Briggs standard pipe gage.
In theory the joint should be tight when pipe has entered fitting a distance equal to H, but to allow for errors, the thread on pipe is cut two threads farther than H. The fitting should be tapped two threads deeper than H for the same reason.
Flush
Reamer.
Tap
Plug for Testing Fittings.
Joint.
Die.
Standard Ring Gage.
Standard Ring Gage and Plug for Testing Fittings.

Diam. of Pipe																				
Nominal Inside	Actual Inside	Actual Outside	Number of threads per inch	Diameter at end of pipe	Diameter at bottom of thread	Depth of thread	Length of perfect thread	Number of perfect threads	Total length of thread	No. turns pipe screws into fitting by hand	Distance pipe screws into fitting by hand	Number of turns made with wrench	Distance pipe screws into fitting with wrench	Total No. of turns pipe screws into fitting	Total distance pipe screws into fitting	Diameter drill to be used with pipe reamer	Diameter of reamer at large end of reamed hole	Length of thread on plug end ring gage	Number of threads on plug end ring gage	Diameter of end of pipe for testing fittings	Distance inspector looks through ring gage
	A	B		C	D	E	F		G							H		K	L		M	N
1/8	0.405	0.840	27	0.815	0.701	0.057	0.39	5.40	0.818	4	0.285	1.40	0.105	5.40	0.30	23/32	0.719	0.533	7.40	0.900	0.247
1/4	0.534	1.050	18	1.025	0.911	0.057	0.40	5.80	0.826	4	0.285	1.80	0.115	5.80	0.40	29/32	0.929	0.543	7.60	1.009	0.257
1	1.048	1.315	11½	1.283	1.144	0.089	0.51	5.87	1.03	4½	0.391	1.37	0.119	5.87	0.51	1 3/16	1.170	0.894	7.87	1.265	0.293
1½	1.380	1.660	11½	1.626	1.488	0.089	0.54	6.21	1.06	5	0.438	1.21	0.105	6.21	0.64	1 5/32	1.515	0.714	8.21	1.608	0.279

FIG. 2. BRIGGS PIPE THREAD AND GAGE DIMENSIONS

This fitting, in spite of the admirable service it has given when employed with the slowly reciprocating and now practically obsolete piston drill, has not proved so satisfactory when used with the modern hammer drill. The reason for this is that the heavy vibration occasioned by the rapidly reciprocating piston of the hammer drill causes an unscrewing of the union nut, owing to the fact that, in order to provide sufficient strength, the screw threads must be made with a coarse pitch. If an attempt is made to remedy this by making the screw threads of finer pitch there is a tendency of the thread to strip, and especially so when a soft material, such as bronze or cast or malleable iron, is employed.

It will be realized, in this connection, that, to lock the union nut, it must be screwed down more tightly if coarse threads are used than would be necessary if it were made with finer threads, and in both cases this forcible screwing down of the nut causes the gasket to be distorted, oftentimes resulting in a restricted opening. Obviously, to avoid the defects of a gasket the logical thing to do is to omit the gasket and secure the air-tight joint by other means. If these means will function without necessitating a forcible screwing down of the union nut, a finer pitch thread may be used, and the latter will permit the locking of the union nut in position. Such means is admirably provided by the expedient of employing a conical joint between the abutting faces of the nipple and spud. Although such a style of coupling lends itself more readily to the use of soft materials than the earlier type, any tendency of the threads to strip is entirely eliminated by the modern practice of employing heat-treated steel. Except for the conical joint and the type of threads, it is believed advisable to retain the other features of the earlier design.

Having suggested what appears to be the most practicable design of hose coupling, it is now incumbent upon me to indicate the form and dimensions of screw threads to be used. For this purpose it is advisable that the Briggs Standard pipe thread be adopted for all external threads, and that the internal threads of cooperating parts be tapped straight and made of a pitch and thread angle corresponding to that of the external threads and of a diameter equal to that of the second

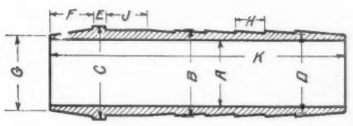


FIG. 3

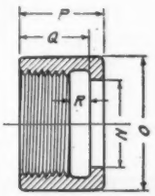


FIG. 4

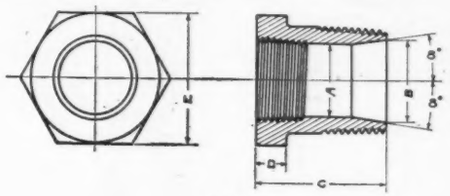


FIG. 5

NOMINAL INSIDE DIAMETER OF HOSE.	SIZE OF BRIGGS STD. PIPE THREAD APPLIED AS BASIS.	INCLUDED ANGLE OF CONE.	HOSE NIPPLE									
			A	B	C	D	E	F	G	H	J	K
1/2	1/2	16°	13/32	9/16	45/64	1/2	1/8	7/16	.553	3/8	7/16	2 3/16
3/4	3/4	16°	5/8	13/16	59/64	3/4	5/32	15/32	.745	3/8	7/16	2 9/16
1	1	16°	13/16	1 1/16	1 5/32	1	5/32	17/32	.951	3/8	7/16	2 15/16
1 1/4	1 1/4	16°	1 1/32	1 7/16	1 1/2	1 1/4	3/16	5/8	1.257	3/8	7/16	3 3/8

DIAMETER OF THREAD.	NUMBER OF THREADS PER INCH.	UNION NUT				
		N	O	P	Q	R
.845	14	27/64	1 1/4	13/16	1/4	1/4
1.055	14	33/64	1 1/2	13/16	25/32	7/32
1.320	11 1/2	1 5/64	1 5/8	1 1/16	29/32	1/4
1.665	11 1/2	1 21/64	2	1 3/8	1 5/16	9/32

NOMINAL INSIDE DIAMETER OF HOSE.	SIZE OF BRIGGS STANDARD PIPE THREAD APPLIED AS BASIS.	INCLUDED ANGLE OF CONICAL BORE.	ADAPTER SPUD				
			A	B	C	D	E
1/2	1/2	16°	17/32	.623	1 9/32	5/16	1 1/16
3/4	3/4	16°	23/32	.824	1 5/8	11/32	1 7/16
1	1	16°	15/16	1.048	1 5/8	3/8	1 13/16
1 1/4	1 1/4	16°	1 3/16	1.380	1 3/4	7/16	2

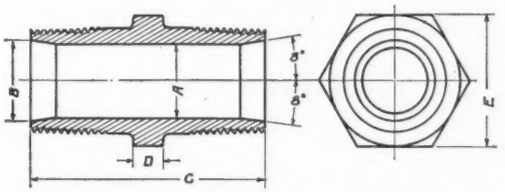


FIG. 6

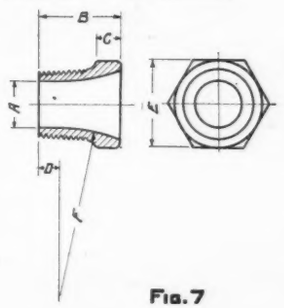


FIG. 7

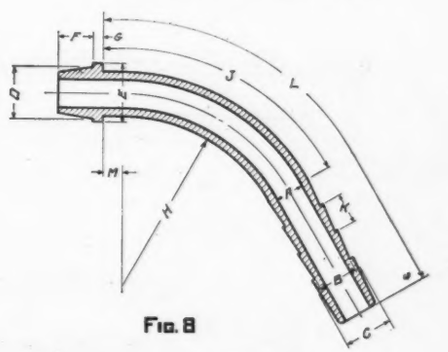


FIG. 8

NOMINAL INSIDE DIAMETER OF HOSE.	SIZE OF BRIGGS STANDARD PIPE THREAD APPLIED AS BASIS.	INCLUDED ANGLE OF CONICAL BORE.	COUPLING SPUD				
			A	B	C	D	E
1/2	1/2	16°	17/32	.623	2 1/4	5/16	1 1/16
3/4	3/4	16°	23/32	.824	2 1/2	11/32	1 7/16
1	1	16°	15/16	1.048	2 7/8	3/8	1 13/16
1 1/4	1 1/4	16°	1 3/16	1.380	3	7/16	2

NOMINAL INSIDE DIAMETER OF HOSE.	SIZE OF BRIGGS STD. PIPE THREAD.	UNION NUT WITH EXTERNAL THREAD					
		A	B	C	D	E	F
1/2	1/2	17/32	1	1 1/16	1/4	1 1/16	2 3/32
3/4	3/4	27/32	1 3/32	1 11/32	1/4	1 7/16	2 1/16
1	1	1 3/32	1 11/32	1 3/8	1/4	1 13/16	2 15/32
1 1/4	1 1/4	1 11/32	1 15/32	1 7/16	1/4	2	3 1/16

NOMINAL INSIDE DIAMETER OF HOSE.	SIZE OF BRIGGS STD. PIPE THD.	INCLUDED ANGLE OF CONE.	30° BENT HOSE NIPPLE											
			A	B	C	D	E	F	G	H	J	K	L	M
1/2	1/2	16°	13/32	1/2	7/16	41/64	49/64	1/4	1/2	2 3/32	2 1/4	3/8	4 7/16	4
3/4	3/4	16°	5/8	3/4	13/16	25/32	29/32	5/16	5/8	2 1/16	2 5/8	3/8	4 5/8	4
1	1	16°	13/16	1	1 1/16	1 3/32	1 5/32	3/8	5/8	2 15/32	3 1/8	3/8	5 3/8	4
1 1/4	1 1/4	16°	1 1/32	1 1/4	1 5/16	1 7/16	1 1/2	3/8	3/4	3 1/16	4 3/8	3/8	6 1/2	4

COMPONENT PARTS OF HOSE FITTING WITH REFERENCE TABLES FOR BRIGGS PIPE THREAD SIZES

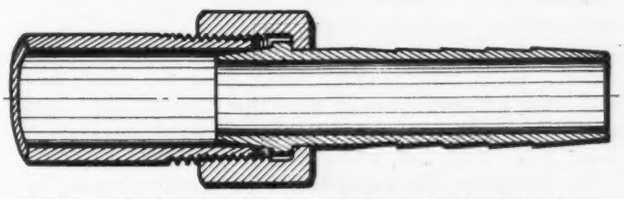
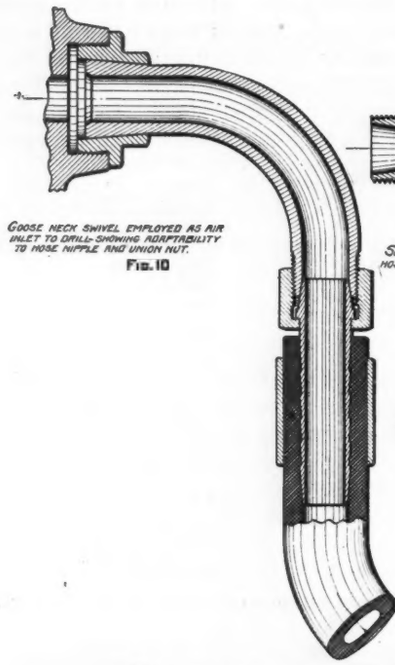
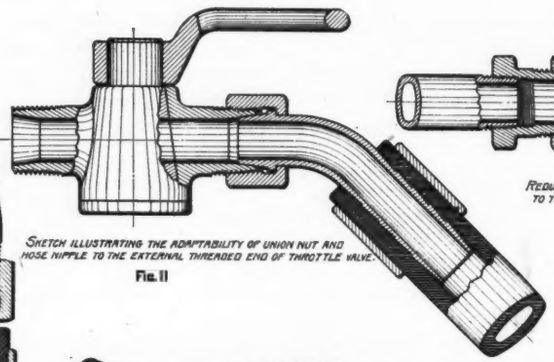


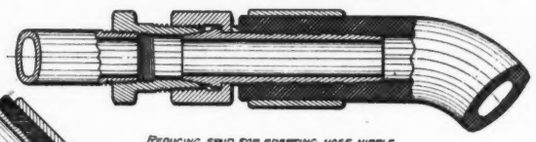
FIG. 9. ADAPTABILITY OF COUPLING TO THREADED PORTION OF STANDARD PIPE FITTINGS



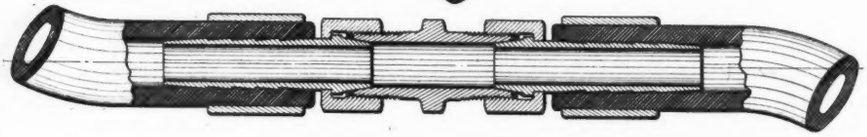
GOOSE NECK SWIVEL EMPLOYED AS AIR INLET TO DRILL—SHOWING ADAPTABILITY TO HOSE NIPPLE AND UNION NUT.
FIG. 10



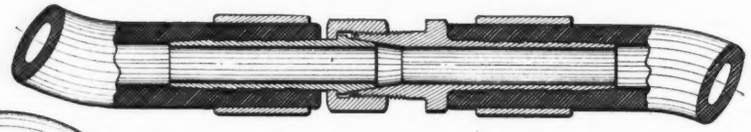
SKETCH ILLUSTRATING THE ADAPTABILITY OF UNION NUT AND HOSE NIPPLE TO THE EXTERNAL THREADED END OF THROTTLE VALVE.
FIG. 11



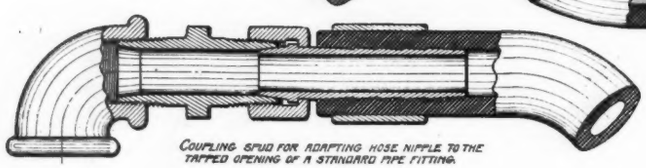
REDUCING SPUD FOR ADAPTING HOSE NIPPLE TO THE THREADED END OF WROUGHT IRON PIPE.
FIG. 12



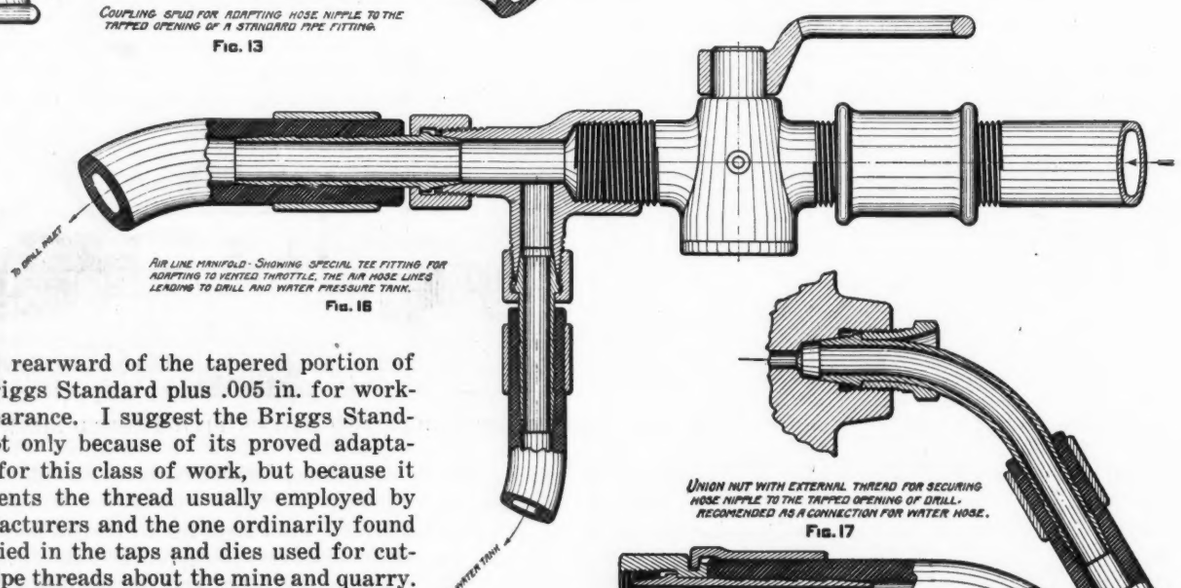
COUPLING SPUD FOR FASTENING TOGETHER TWO PIECES OF HOSE EQUIPPED WITH HOSE NIPPLES AND UNION NUTS.
FIG. 14



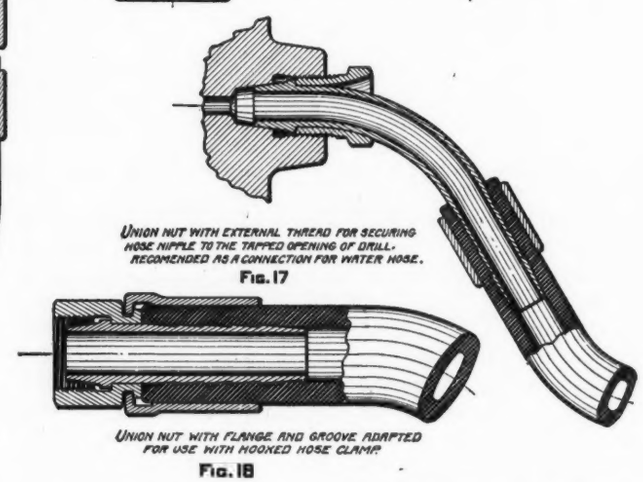
THREADED HOSE NIPPLE WITH SOCKET, ADAPTABLE TO EITHER A UNION NUT WITH HOSE NIPPLE AS SHOWN OR TO A PIPE TAPPED FITTING.
FIG. 15



COUPLING SPUD FOR ADAPTING HOSE NIPPLE TO THE TAPPED OPENING OF A STANDARD PIPE FITTING.
FIG. 13



AIR LINE MANIFOLD—SHOWING SPECIAL TEE FITTING FOR ADAPTING TO VENTED THROTTLE, THE AIR HOSE LINES LEADING TO DRILL AND WATER PRESSURE TANK.
FIG. 16



UNION NUT WITH EXTERNAL THREAD FOR SECURING HOSE NIPPLE TO THE TAPPED OPENING OF DRILL. RECOMENDED AS A CONNECTION FOR WATER HOSE.
FIG. 17

UNION NUT WITH FLANGE AND GROOVE ADAPTED FOR USE WITH HOOKED HOSE CLAMP.
FIG. 18

thread rearward of the tapered portion of the Briggs Standard plus .005 in. for working clearance. I suggest the Briggs Standard not only because of its proved adaptability for this class of work, but because it represents the thread usually employed by manufacturers and the one ordinarily found embodied in the taps and dies used for cutting pipe threads about the mine and quarry.

Fig. 2 illustrates a section of the Briggs Standard pipe thread, with tables and formula for determining its proportions.

Figs. 3, 4, 5, 6, 7 and 8 comprise sketches of hose nipple, union nut, adapter spud, coupling spud, union nut with external thread, and the 30-deg. hose nipple with reference tables for each, giving dimensions for ½-in., ¾-in., 1-in., and 1¼-in. Briggs pipe thread sizes.

To facilitate the engagement of screw threads, it is recommended that in all cases the end of all external threads and the mouth of the tapped opening shall be beveled at an angle of 45 deg. for a distance back approximately one and one-quarter times the pitch of the thread.

To provide a means for tightening the joint of the hose connection by hammering, when a wrench is not available, the union nut and spud may be equipped with protrusions, if desired, but the hexagonal section shown by the drawings is recommended, especially as the various sizes required conform to the jaw width of the standard, solid, open-end wrenches commonly supplied as a part of the equipment of the modern hammer drill.

To summarize, the advantages to be gained by the use of the hose coupling above suggested as a standard are: First, its present use as the usual standard in the shop and field for pipe fittings; second, the practicability of making taps for cutting the internal thread by grinding off the taper portion of a pipe tap; third,

the locking of the union without the necessity of overstraining the parts by strongly screwing down the union nut; fourth, the adaptability of the coupling to the threaded portion of standard pipe fittings as illustrated by Fig. 9; fifth, dispensing with the necessity of using objectionable gaskets; sixth, the provision of an air-tight, friction swivel joint which will maintain its angular position (oftentimes desirable when a bent nipple or gooseneck is employed); seventh, the practical elimination of stresses due to vibration and weight of the hose from the screw threads holding the union nut in position by causing the socketed joint between the hose nipple and spud to take the major portion of this strain, and eighth, the ease with which the union nut may be started when screwing it into position, as afforded by the tapered external thread of the spud.

Of course, as with all other things that the manufacturer offers the miner and quarryman, the proposed hose coupling will have some disadvantages, but clearly these will be outweighed by the advantages. The only serious objection that may be raised against the practical use of this hose coupling is the tendency of the relatively fine-pitched threads to strip when soft metals are used. However, as has been before pointed out, this can be obviated by the employment of heat-treated steels, which in recent years have been used by most up-to-date manufacturers instead of the softer metals.

The wide adaptability to various uses to which the proposed standard pipe fitting may be put are aptly shown by the accompanying illustrations. Fig. 10 illustrates the adaptability of the suggested form of hose fitting and union nut to the commonly employed gooseneck swivel as an air inlet connection to the drill. Fig. 11 illustrates the adaptability of union nut and hose nipple to the external threaded end of a socketed throttle valve. Fig. 12 shows the type of reducing spud recommended for adapting the hose fitting to the threaded end of wrought-iron pipe. Fig. 13 depicts the coupling spud as used for adapting hose nipple to the tapped opening of a standard pipe fitting. Fig. 9 illustrates the adaptability of hose nipple and union nut to the threaded end of standard wrought-iron pipe. This connection is recommended only as a makeshift, because of the liability of leakage in the event that the pipe bore is of irregular shape, but it will be seen that a satisfactory air-tight joint may be secured by taper reaming the mouth of the pipe for a short distance. Fig. 14 illustrates the adaptability of the coupling spud for fastening together two pieces of hose equipped with hose nipples and union nuts. Fig. 15 shows a threaded hose nipple with socket adaptable to either a union nut with hose nipple, as shown, or to a pipe-tapped fitting. Fig. 16 illustrates an air-line manifold, showing a special tee fitting employed for adapting to a vented throttle the air-hose lines leading to drill and water-pressure tank.

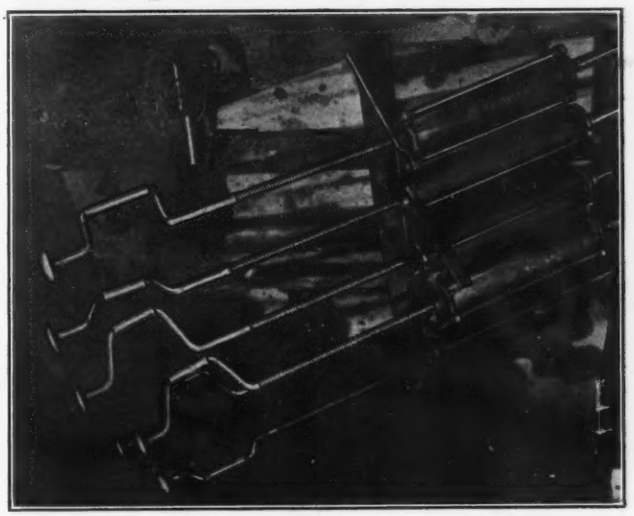
In case it is desired to attach the hose directly to an integral part of the machine, such as the water connection in rock drills employing water for sludging the drill hole, the type of adapter and socket illustrated in Fig. 17 is recommended, for the reason that it is adaptable to an internally threaded opening. If an external thread, adaptable to the type of union nut illustrated by the figures referred to, is employed, it would be very susceptible to breakage or battering, as rock drills are usually handled with little respect for finished or machined protrusions.

In the foregoing illustrations no provision is made for interlocking the hose clamp with the hose nipple, for the reason that the desirability of such a feature is minimized by the employment of a machined part instead of the older type of cast nipple, which is usually made with its grooves or corrugations having rounded edges. A plain hose clamp made in halves and fastened by two bolts will, in the majority of cases, suffice for the requirement, but if a hooked clamp is found to be necessary the union nut may be equipped at the hose end with a flange and groove (Fig. 18) adapted to be engaged by the hook of the clamp.

The Grease Gun

Large bearings working under heavy load and so placed as to be inconvenient of access entail a real problem from the lubrication standpoint. Where such bearings operate under conditions that might permit the entrance of sand, the use of grease for lubrication and the filling of the entire bearing space with the grease effectively keep out sand.

The lower tumbler on the bucket line of a gold dredge, as well as the rollers supporting the upward-moving bucket line, furnish an excellent example. Both lower tumbler bearings and the bearings of the rollers are lubricated with grease. The grease is applied with a



GREASE GUNS USED ON GOLD DREDGES

grease gun, which consists of a cylinder filled with grease into which a piston is forced down by a screw discharging the grease through a small pipe which is attached by a threaded end to an opening in the bearing. After charging a bearing the opening is closed by a screw plug.

The photo shows a set of grease guns on one of the gold dredges of the Yuba Consolidated Goldfields Co.

Separating Flocculated Flotation Concentrate

Some minerals, such as molybdenite, flocculate to a considerable extent when concentrated by the flotation process. Other gangue minerals may also be floated, but are not recovered in the flotation concentrate in floccular form. In such cases the desirable flocculated concentrate may be separated by screening. E. B. Thornhill, in U. S. Patent No. 1,338,264, granted April 27, 1920, uses for this purpose a Callow screen of 80 mesh when the original pulp is ground to 100 mesh.

A Picturesque Mining Experience

A Tale of Air and Water and a Bad Scare

BY LIEUT. COLONEL GEORGE SYDNEY BINKLEY

LIFE in the Catorce mining district twenty-five years ago had its picturesque side, and as memory runs back over the events of those sometimes hectic days —and nights—the softening effect of time doesn't blur

LIEUT. COLONEL GEORGE SYDNEY BINKLEY

the picture much. Indeed, things that were simply part of the day's work then take on now a truer color of romance and adventure. And the "boys" of those days, too! Wild devils, beyond doubt, yet for the most part staunch he-men at that. Who could forget Big Bill —the turbulent, typically American miner, ore buyer, and general disturber of the peace! Then there was (and indeed still is) Don Mauricio, hair-brained, reckless centaur from the northern frontier—a good friend and a fine fellow, but quick on the trigger—very. Mexican, American, Britisher, and Spaniard, all of us were in and part of the life of that mountain-top mining camp, and our occasional and generally accidental gatherings were rarely lacking in a certain enterprising cheerfulness.

Tragedy and near-tragedy were with us often in the mines, but a mere hair-breadth escape was an occasion for ribald remarks. Of funny things there were plenty, and one of these sticks in my memory in all its original mixture of horrid anxiety and absurd burlesque.

This thing had its start some time before, when, in sinking the main shaft of the Santa Ana mine, a heavy flow of water was suddenly developed, with no pumps to handle it; so, of course, the shaft was promptly drowned out—one could hardly climb a ladder ahead of the water. The manager, Don Francisco, was a man of action, so he at once rigged up a bailing tank, attached it to the cage, and started in to bail so as to determine as far as possible the rate of flow and required capacity of pumps. This was going on quite well until the cage got stuck about seventy-five feet below the water. How a bailing tank ever got so far down the shaft I don't know, but it doesn't matter. It was stuck and wouldn't move.

Now, Don Francisco was not alone a man of action, but a man of resource. He called for a volunteer (or merely selected one perhaps), and the lucky man, Petronilo, loaded with a sinker of scrap iron lashed to his feet, was given the appropriate tools, and, with beautiful simplicity, lowered into the water and down the shaft to the cage, and left at work there until it was considered that he had better be hauled out and given some air. This kind of a keel-hauling operation was gone through with three times, the wretched Petronilo at the third trip clearing the cage in self-defense, and coming up rather frayed at the edges.

Don Francisco, who was as progressive as he was resourceful, decided about this time that a diving dress might possibly be an improvement in method in case of future emergency (I think Petronilo agreed with this), and purchased forthwith a beautiful four-cylinder pump and two complete diving outfits.

Just here the story begins. Looking to the future, Don Francisco asked me if I knew anything about deep-sea diving. Well, I knew almost everything (being young), but this was a bit out of my line. Nevertheless, I was expected (because I am an American, I suppose) to select a man, teach him the art of deep-sea diving, and complete his education by giving him a try-out in a large concrete tank up on the hillside. Naturally, I couldn't be backed down, so I looked around.

There was on the job a Spaniard with the impressive name of Maximimo Margarito de la Luz attached to his personality. Now, Max was a chap you couldn't get to admit ignorance of anything, so I was not surprised to have him volunteer for the job of diver, stating casually that he had been down in a diving dress at Vera Cruz, and knew all about it. I was skeptical, on general principles, but had the rig taken out, and got Maximimo into one of the diving suits. I don't know what idea the maker of that suit had of the size of the average

Mexican, but it was liberal. A man to fill that suit would have weighed three hundred and forty pounds if an ounce; but we put the little Spaniard in, balanced the vast helmet on his shoulders, tightened up the joints, started the pump, and then I screwed on the glass front plate. The pump steadily turned, Maximimo grinned through the glass, and all seemed well.

Then a strange thing happened. Slowly the helmet rose, and rose, and as it still rose the bristling moustache inside disappeared, then the nose, and at last, as I stood on tiptoe before this towering giant and looked in the face-plate, the top of Max's head had disappeared. Hypnotized by this strange phenomenon, I watched, fascinated, as his arms slowly rose, and seemed to feebly wiggle a signal. Whereupon it suddenly struck me that Maximimo might be uncomfortable, so I hastily reached up, unscrewed the face-plate, and he collapsed like a wet paper bag. It didn't hurt him any. But somehow I began to suspect that there were probably a few things about deep-sea diving I didn't know. One thing I *did* know, however, and that was that Maximimo Margarito de la Luz was a liar when he said he had been in a diving dress before.

Well, Don Francisco said he thought we had better give him a try-out in the tank. I admit I was glad he didn't suggest the shaft, but I don't believe he thought of it. Anyhow, we had the air pump and the hose lugged up to the side of the big rectangular tank, put Max in his suit down at the machine shop, cast-iron shoes, lead belt and all, and in our profound inexperience overlooked the fact that he would have to climb the hill in this toggery. But he did it, like a hero. And so it was that we came to the tank—a rectangular affair of large size, with seven or eight feet of clear water in it. We arranged an elaborate system of signals, managed to get Max, by dint of tremendous efforts, up to the edge of the tank and on the ladder leading down to the bottom inside, and screwed on the face-plate. The pump steadily turned, and Max began a slow clumsy descent. But he was very slow indeed. He got down to the water, his cast-iron shoes and rubber legs immersed, and then he hesitated and seemed minded to come back. And with a disturbing sense that something was wrong, I saw that his vast suit was becoming bloated and enormous—and about this time, the rubber-gloved hands of the wretched Maximimo relaxed their hold on the ladder, his arms spread out, and he capsized, floating like a dead horse, his helmet under the surface, and not a sign of life.

"Válgame' Dios! We have killed the man!" yelled the startled Don Francisco, and poised as we were on the narrow edge of that concrete tank, with the thin life line in our hands, we dragged desperately at it. But there was nothing doing. Max and his suit and his appurtenances were too much for us—he weighed a ton. Something had to be done, and that quickly, so I jumped into the tank while Don Francisco held the rope, got on the bottom under Maximimo, and pushed up, Don Francisco taking in the slack. When I couldn't push any further, I got on the ladder with my head above the surface and hoisted again. Max seemed dead as a ham. But as I reached to unscrew the face-plate (I had his head above water now) I heard the sweetest sound that ever came to my ears—the muffled voice of Maximimo Margarito de la Luz yelling inside that diving dress, "Arriba! Arriba!"

His bloated figure wilted instantly as the air rushed out through the helmet, and at last we got him up. Then it appeared that the spring of the air valve in the helmet was too stiff, and as the suit became inflated poor Max was spread-eagled in spite of his heroic efforts, and had to let go all holds. So we stood him up, took reefs in his arms and legs and body by winding some mecates around him, changed the air spring, and triumphantly sent him in again with perfect success and much hilarity.

But for a few minutes that day the United States seemed a long way off—and a Mexican prison mighty close at hand.

To Investigate New Uses for Selenium And Tellurium

Selenium and tellurium have recently been given a considerable amount of study by a sub-committee of the National Research Council. These two elements are produced in large quantities in the electrolytic refining of copper, appearing in the anode mud. By a simple process they can be produced in a pure condition in marketable form. Little use has been found for these elements, except for the war-time employment of selenium in the glass business when manganese was scarce, and it is the desire of the committee to co-operate with those who are interested in the systematic study and research which are necessary in order that these elements can be utilized.

The copper refineries can supply at present approximately 300,000 lb. of selenium and 125,000 lb. of tellurium a year without materially altering their plants, and larger quantities could probably be economically produced. At present the annual consumption is not more than a few hundred pounds.

The sub-committee, consisting of Arthur E. Hall, chairman; H. G. Greenwood, Victor Lenher, O. C. Ralston, E. W. Rouse, S. Skowronski, and A. W. Smith, has been working with all of the producers of selenium and tellurium in the United States. Arrangements have been made with the Raritan Copper Works, Perth Amboy, N. J.; the United States Metals Refining Co., Chrome, N. J.; the American Smelting & Refining Co., Omaha, Neb.; and the Baltimore Copper Smelting & Rolling Co., Baltimore, Md., to furnish workable quantities of these elements for research purposes at cost price. E. W. Rouse, of the Baltimore Copper Smelting & Rolling Co., Baltimore, Md., has agreed to ship reasonable quantities of selenium to investigators, free of charge, provided the request has the approval of the committee, and A. E. Hall, of the Omaha plant of the American Smelting & Refining Co., will furnish tellurium under the same conditions.

The Birdman's View of Dredging

Four photographs under the above general caption were reproduced in *Engineering and Mining Journal* of April 17. It was erroneously stated that the views were those of the Yuba dredging field, whereas they portray parts of the Oroville field. It has been recently pointed out by a correspondent that the pictures show both spud and headline dredging. There is no headline dredging in the Yuba field.

Magnetite Ore, containing 38.8 per cent of iron, is mined by Moose Mountain, Ltd., at Sellwood, Ont. It is concentrated and made into briquets containing about 61 per cent of iron.

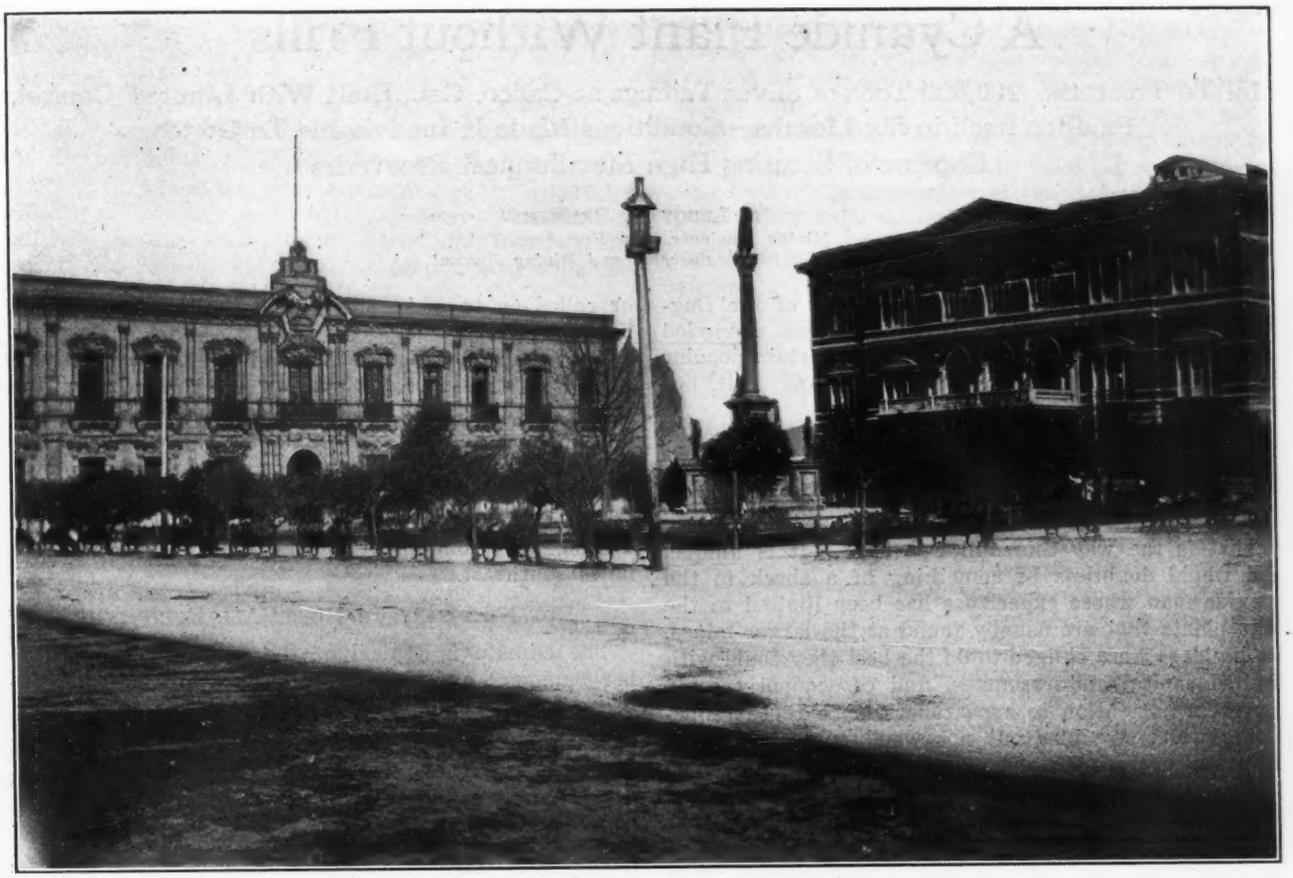
Photos About Chihuahua, Mexico

ONE METHOD OF TRANSPORTATION AS PRACTICED IN MEXICO. ON THE TRAIL, MINACA TO OCAMPA

Primitive trains of pack animals are still a familiar sight in connection with the development of mines in Mexico. These "mountain canaries" are able to carry what appear to be staggering loads.

A "POSADA," OR REST HOUSE, ALONG THE ROAD BETWEEN MINACA AND OCAMPA

An interesting feature is the ancient cart in the foreground, which has performed yeoman service in Mexican transportation



THE PLAZA OR CIVIC SQUARE IN CHIHUAHUA CITY, MEXICO

SILVER BULLION AWAITING SHIPMENT. STANDING ON THE EXTREME LEFT IS W. G. HONNOLD

A Cyanide Plant Without Frills

Mill To Treat the 200,000 Tons of Silver Tailings at Calico, Cal., Built With Limited Capital, Paid for Itself in Six Months—Conditions Made It Inadvisable To Go to Expense of Securing High Metallurgical Recoveries

By Leroy A. Palmer
Mining Engineer, San Francisco, Cal.
Written for *Engineering and Mining Journal*

AS I LOOKED over the cyanide plant of the Daggett Reduction & Milling Co., I was reminded of a rhyme I once heard about a certain popular make of automobile. I do not remember all of it, but it ended,

He took four spools
And an old tin can,
And put 'em together,
And the damned thing ran.

That is the way this mill was built. It is unique, and would doubtless be something of a shock to the cyanide man whose experience has been limited to the trim plants that are usually found at the larger mines. Its builders were obliged to do the best they could with limited capital and resources, and consequently could give scant attention to appearances or to those refinements which are nice but not wholly necessary from a strictly operating standpoint. As a result, its frame is of wood instead of steel, its floors are of earth instead of concrete, and such light as gets in through the roof does not come by means of a gabled skylight. All of its equipment saw service elsewhere before it was installed in this mill, and it rests on wooden sills instead of concrete piers. But with all of these features, this plant is accomplishing the purpose for which it was built, and under the present management paid for itself in six months of operation.

Conditions attendant on its construction, and having an effect on the capital expenditure advisable, were briefly the following: The plant was designed and built in 1916 and 1917 to treat the tailings of two of the old stamp mills of Calico. At that time, the price of silver was low, and there was no immediate prospect of its betterment. Previous attempts at treating the tailings of the Calico mills had failed; so that the enterprise appeared to the investors as a gamble.

A further consideration was the limited amount of material available for treatment. It was not like building a plant for a mine with a large ore reserve blocked out for a mill run of many years and a possibility of developing indefinitely. Instead, there was a certain amount of material in such position as to be susceptible of accurate measurement, and after that was gone no more was available. Consequently, good business practice demanded that the original construction be accomplished as cheaply and with as much simplicity of design as possible, even if it might be necessary, with respect to some points, to sacrifice theoretical metallurgical efficiency to economy in construction and operation costs.

The following is intended by no means as a technical treatise on cyaniding, but is presented for the purpose of showing what can be done under unfavorable financial conditions, in the hope that it will be of assistance to others who may be confronted by similar problems or called on to make shift, with limited facilities, as best they can.

The camp of Calico, which had its greatest activity in the late 80's, is situated in the foothills of the Calico Mountains, in western San Bernardino County, Cal. The tailing plant is on the alluvial outwash slope of the mountains about two miles southeast of the town and five miles north of Daggett, the junction of the Santa Fé and Los Angeles & Salt Lake railroads. Yermo, a division point on the latter, is about three miles southeast.

Not Necessary To House All Equipment

The climate is typical of the southwestern desert, hot summers and mild winters, with little rain, the precipitation at Barstow, ten miles distant, averaging less than four inches per year. The mild winter climate

GENERAL VIEW OF DAGGETT REDUCTION & MILLING CO.'S PLANT

made possible an economy in construction in that only the machinery which it is necessary to protect from the elements is under roof. Solution tanks, leaching vats, agitator, and thickeners are in the open on the east side of the mill. At first thought it might appear that the heat of summer, which is extreme, would entail a serious evaporation loss, but on exposed surfaces of bodies of solution, of the depth found in the tanks and vats, and protected, whether intentionally or not, from the prevailing winds, it is not probable that this loss will be more than one inch in twenty-four hours.

The ores of the Calico district were principally chlorides and bromides of silver in a gangue of quartz and barite. They were treated by pan amalgamation, usually by the Boss continuous process. Under conditions existing at the time of the greatest activity in

the camp, only comparatively high-grade ores were milled, and as a natural consequence the tailing dumps of the old mills offer favorable opportunity for retreatment.

The Daggett Reduction & Milling Co. was organized for the purpose of working the dumps of the Runover and Barber mills on lease. Present operations are on the dump of the old thirty-stamp mill of the Runover, which is estimated to contain 150,000 tons. The Barber mill was smaller than its neighbor and was not in operation for as long a time. It accumulated a dump estimated at 50,000 tons.

The Runover dump has an average assay value of 3.6 oz. silver, 60c. gold, and one-half pound of mercury per ton, most of the mercury being in the form of amalgam with a part of the gold and silver. Screen tests show that on the whole the material is quite evenly divided between plus and minus 200 mesh, although this proportion is not maintained in the daily feed, which is likely to vary considerably. Many of the sands are coarse, a considerable proportion being as large as ten mesh.

The mill has been built a short distance down the hill from the Runover dump, so that the tailings can be delivered to it by gravity. A V-launder, 16 in. wide and 10 in. deep, has been built from the upper portion of the dump to the mill, 1,400 ft. distant. To facilitate collecting the tailings for feeding, the launder is laid close to the ground, so that its fall of 47 ft. in 1,400 represents the general slope of the country.

How the Tailings Are Recovered

Feeding is a simple process. Two-inch boards, 1 ft. wide and 2½ ft. long, are laid across the launder for a distance of 40 ft. at any convenient point. With the boards in place, a man with a two-horse team and a Fresno scraper builds upon them a pile of tailings about three feet high. The tailings are then fed into the launder by hoeing them in from one end of the dump thus formed. As one of the boards at the end of the pile is uncovered, it is taken up and laid to one side, so that little actual labor is required to move the tailings, which, being loose dry sand, run easily. The mill is treating seventy-five tons in two eight-hour shifts. One shift, with the team and scraper, and two shifts of one man each feeding with the hoe, keep it supplied.

The feed is flushed to the mill in solution, which is pumped from the mill sump to the head of the launder. The strength of this solution is varied according to the proportion of sands and slimes. At the time that these notes were made, the proportion of sands was high and a solution of 0.7 lb. NaCN per ton was being used. This strength is reduced as the amount of slime increases, and solutions as low as 0.2 lb. NaCN per ton have been used when the greater portion of the feed was slime. About 30 per cent of the values go into solution in the feed launder.

At the mill, the launder discharges to a circular steel feed tank 3 ft. deep and 8 ft. in diameter. As the dump, in the many years since it was formed, has grown up with sagebrush, grease wood and other desert vegetation, the feed is discharged to a basket, 4 x 4 ft. square, of heavy ¼-in.-mesh wire. The basket is hung in the feed tank and catches the vegetable matter and other débris, which is cleaned out from time to time with a hoe.

Sands and slimes are separated in a 45-in. Akins classifier, making 6½ r.p.m. and connected by a launder with the feed tank. Lime at the rate of 1 lb. per ton of feed is introduced by hand at the classifier intake.

At the head of the classifier are three Frenier sand pumps, each 5 ft. in diameter and working against a 17-ft. head. The sand from the classifier is delivered to the first of these pumps and elevated to one of the three leaching vats, each of which is 5½ x 20 ft.

Method of Separating the Slimes in Leaching Vats

In filling a leaching vat, the feed is not discharged through a mechanical distributor, as is the usual custom, but is run in directly from the line from the Frenier pump, which has its outlet at the side of the vat farthest from the mill. This builds up the sands a little on that side, so that the solution, with such fine slimes as it may carry in suspension, flows across the vat to the side nearest the mill. Here a square wooden drain is built vertically against the inside of the vat. The drain is made of slats set on an angle horizontally, so that the lower edge of one is somewhat lower than the upper edge of the next one below. A space is left between, the arrangement of the slats being somewhat like that of the shutters on a window blind. To enter the drain, the solution must pass under one slat and over the next, which it partially overlaps, so that the slimes which are carried in suspension pass out through the drain, the sands being retained in the vat. This leaves the vat free of slime, a condition that is a distinct aid to uniform and rapid percolation of the leaching solutions.

Approximately seventy-two hours are required to fill and level a vat. After filling, a solution of 1 lb. per ton is turned on for the first twenty-four hours and a 2-lb. solution for the second twenty-four hours. This is followed by a weak solution, 0.3 lb. per ton, for twelve hours, after which wash water is run on until all solution is displaced, requiring fifteen to eighteen tons of water in about twelve hours. Thus a leaching cycle occupies seventy-two hours' time.

The leaching vats are equipped with side-discharge doors, and are emptied by flushing out the sands with a hose. As the general slope of the ground, as shown by the figures given for the feed launder, is only 0.4 in. per foot, the plant is at a disadvantage in the matter of tailing disposal. The slope is too low to give much dump room, and to discharge by flushing, which is the most economical method when the water is available, it is necessary to lay the launder closely to grade and lengthen it often. Mechanical delivery or elevation of the tailings is being considered, and it is probable that some such means of overcoming this difficulty will have to be adopted.

Slime Treatment a Straight Decantation System

The overflow from the leaching vat that is filling is laundered to the second Frenier pump and elevated to the agitator, which also receives the slime from the Akins classifier by way of the third Frenier. The agitator tank is 20 ft. deep, with a diameter of 15 ft., and is equipped with the usual type of revolving agitator, which makes one revolution in twenty-five seconds. The pulp is transferred by an air lift from the agitator to the first of three thickeners, each of the same size as the agitator, and is passed from one thickener to the other by means of diaphragm pumps.

As discharged from the last pump the pulp is 75 per cent solids.

The overflow from the thickeners goes to a 25,000-gal. clarifying tank, 15 ft. in diameter and 20 ft. deep, from which it is drawn to two filter tanks. Each filter tank is 10 ft. in diameter by 6 ft. deep, equipped with a canvas filter bottom covered to a depth of a few inches with sand to remove the last of the solid matter from the solution.

All pregnant solutions, from both leaching vats and filter tanks, are piped to a 50-gal. collecting tank made from a steel gasoline drum, and thence to five zinc boxes, each of which has six compartments, 32 x 24 x 20 in. The barren solution from the zinc boxes is run to a 14,000-gal. sump tank, in which it is brought up to standard and from which a 6 x 8-in. triplex pump raises it to the head of the launder in which the tailings are conveyed from the dump to the mill.

The precipitates contain gold, silver, and mercury. They are gathered in trays and dried in the brick amalgam furnace shown at the left of the illustration. The furnace is maintained at a temperature sufficient to volatilize the mercury, which is recovered in the usual manner, by passing the fumes through a water-cooled worm. The precipitates are shipped to the Selby Smelting & Lead Co., at Selby, Cal.

Water for the plant is supplied from a well 165 ft. deep, equipped with a deep well pump, operated from a jackhead with counter balance. The well is adjacent to the agitator and leaching vats. The plant uses 40,000 gal. per day, this supply being delivered to two tanks of a combined capacity of 50,000 gal. All power is furnished by a 60-hp. gas engine. The mill is treating seventy-five tons a day in two shifts of eight hours, the total force consisting of six men and a superintendent.

Recovery of Gold and Mercury Poor

As noted, the tailings have an average assay of 3.6 oz. Ag, 60c. Au, and 0.5 lb. Hg per ton. Recovery is 78 per cent of the silver, 30 per cent of the gold, and 15 per cent of the mercury. These recoveries are low, due largely, no doubt, to the mercury occurring with the gold and silver as amalgam, which does not yield as readily to the cyanide solutions as the metals do. It is probable, also, that there is a low extraction of the valuable metals from the coarser sands. This brings up the old question of the economic limit of fine grinding. As originally designed, the plant contained a tube mill for regrinding the coarse sands, but its use was discontinued after a thorough trial, as it was decided that the additional saving was not commensurate with the cost of operation.

Sodium cyanide is consumed at the rate of 0.3 lb. per ton of tailings treated. Lime is used at the rate of 1 lb. per ton. Under the conditions outlined, this plant has been operated at a rost of 68c. per ton, the greatest item in the costs being that of labor, for which wages are $4 to $6 a day. Taking all features into consideration, and making allowance for the fact that there is no expense for crushing or fine grinding, this must be considered a creditable showing, especially in view of the fact that it is a reclamation of what had previously been rejected as waste.

I am under obligations to F. A. Shorey, superintendent of the plant, for much of the data presented herewith.

Primitive Copper Metallurgy

By Arthur C. Preston

THE photograph published herewith shows a South American native metallurgist extracting copper from its ore by a process somewhat unusual in the production of that metal. Both mine and mill are shown; the former in the right background, where visiting Yanquis are inspecting the cut in the hillside from which the ore was taken; the latter in the foreground, with the essential details of the process plainly indicated. The product, native copper, is seen sacked for shipment at the operator's side.

The picture was taken by F. C. Martin at San Bartolo, near San Pedro de Atacama, in northern Chile. The mineralization is quite similar to that of the Corocoro district, in Bolivia. It consists of slugs and granules of rusty native copper embedded in sandstone strata which are interleaved among more massive barren sandstone beds. The copper, when recovered, is somewhat similar in appearance to what is known in metallurgical practice as shot copper.

EXTRACTING THE RED METAL ON THE ATACAMA DESERT

The water with which the Indian is sluicing the crushed rock is mine water, the scanty product of a near-by shaft through which a more pretentious effort at development was in progress at the time of our visit three years ago. In this part of the great Atacama Desert, which may fairly be called the most arid region on earth, water is considerably scarcer than copper, and its absence accounts for some interesting mineralogical features of the desert, such as the existence of beautiful large bluestone crystals in surface deposits, and the soluble nitrates in the near-by nitrate fields; and it lends piquancy to the flock of rumors of placer gold deposits which naturally are current in a country where placer prospecting is practically impossible.

Supplies of Zinc Ore for Belgian Industry

Negotiations have been concluded with the British Government for the delivery to the Belgian zinc industry of 240,000 tons of zinc ore within the maximum limit of two years, according to *Commerce Reports*. Many of the zinc works in the Liege district came through the war undamaged and have only been awaiting a supply of raw material to resume operations. The shortage of fuel is serious. Before the war Belgium produced over 20 per cent of the world's zinc.

Air Lift for Mine Drainage

Practical Data and Detailed Description of an Installation in Mexico—Theoretical Quantity of Air Required by the Lift—Details of Footpiece, Discharge Box, and Measuring Weir

BY S. F. SHAW
Written for *Engineering and Mining Journal*

DURING 1919, the Tiro General Mine, at Charcas, S. L. P., Mexico, was unwatered by air lift[1] to a depth of 950 ft. Beyond that point the unwatering was handled by air lift, assisted by a Cameron No. 12 sinker, which pumped the water to the 850-ft. level, from which it was raised to the surface by a Worthington 15 x 23 x 38-in. by 8-in. and a 24-in. triple expansion steam pump.

The air lift was unable to complete the unwatering to the 1,050-ft. level, owing to there being an obstruction in the shaft 1,080 ft. from the collar. The submergence obtainable at this point was only 20 ft., and as the lift above the 1,050-ft. level was about 1,070 ft., the air-lift capacity under these conditions was too greatly reduced to handle the normal mine drainage.

The water was lowered by a sinker to the obstruction 30 ft. below the 1,050-ft. level, after which the air lift, which had been left in one compartment of the shaft, was extended and lowered, and the normal drainage then handled by it alone. This air lift, as extended, is designated as Tiro General No. 5 air lift, the make-up and operation of which will be described.

The steam plant consists of two Heine 160-hp. water-tube boilers and three Erie City water-tube boilers, one of 100 hp., one of 150 hp., and one of 300 hp. Water

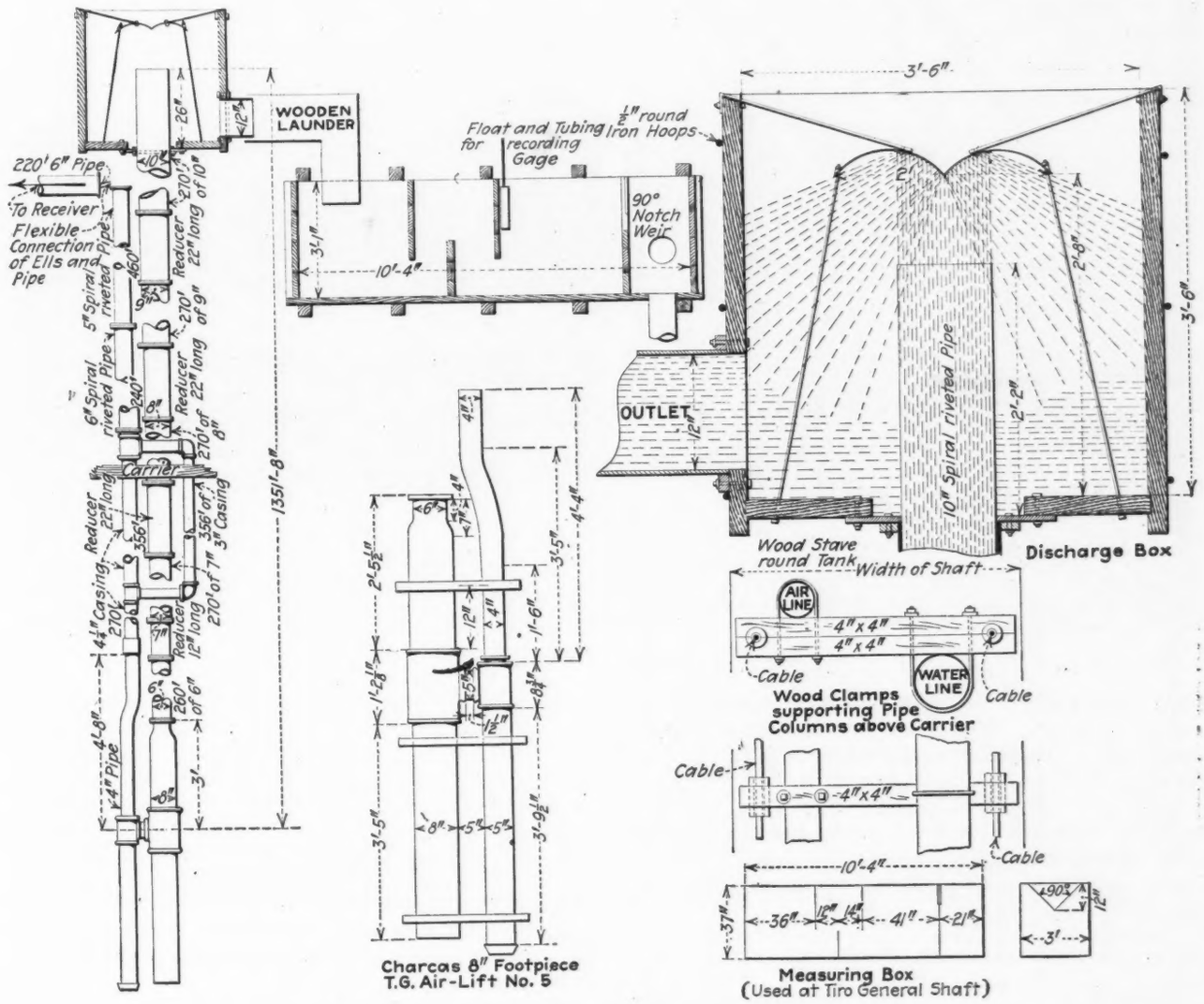


FIG. 1. DETAIL OF AIR LIFT OF NO. 5, TIRO GENERAL MINE

[1] *Mining and Metallurgy*, No. 158, Sect. 35, February, 1920.

is supplied to the boilers by two Worthington 6 x 4 x 6-in., outside-packed, plunger, boiler-feed pumps, which draw their supply from the hot-well discharge of the No. 2 Nordberg condenser pump. The water contains a high content of salts, mostly calcium sulphate, and every effort is made to reduce the quantity of make-up water to a minimum. The condensate from the compressor jet-condenser pumps is raised to a cooling tower and is then conducted to a concrete reservoir, and returned from there to the condenser pumps.

The compressors are Nordberg, cross-compound, two-stage, No. 1, having 13 and 25-in. diameter steam cylinders and 12½ and 22-in. air cylinders with 36-in. stroke, with displacement of 1,235 cu.ft. of free air per min. No. 2 compressor has steam cylinders 16 and 32 in., with air cylinders 16 and 28 in. diameter and 42-in. stroke, the displacement being 2,500 cu.ft. of free air per min.

Water and Air Line—The water line of the Tiro General No. 5 air lift, commonly called the discharge or educator column, is made up as follows (see Fig. 1):

	Feet	Inches
6-in. pipe from center of footpiece to flange	3	0
13 lengths 6-in. spiral-riveted pipe, each 20 ft	260	..
Reducer 6 in. to 7 in	1	..
9 lengths 7-in. spiral-riveted pipe, each 30 ft	270	..
Reducer 7 in. to 8 in	1	10
9 lengths 8-in. spiral-riveted pipe, 30 ft. each	270	..
Reducer 8 in. to 9 in	1	10
9 lengths 9-in. spiral-riveted pipe, each 30 ft	270	..
Reducer 9 in. to 10 in	1	10
9 lengths 10-in. spiral-riveted pipe, each 30 ft	270	..
Nipple in headpiece	2	2
Total length water pipe	1,351	8

The air line was made up as follows:

	Feet
6-in. air main from receiver to shaft	225
5-in. spiral-riveted pipe	460
6-in. spiral-riveted pipe (to carrier)	240
3-in. and 4¼-in. casing parallel, below carrier	356
4¼-in. casing alone	270
Total length of air line	1,551

Footpiece—The footpiece consists of an 8-in. pipe into which the air is delivered through a tee, as shown in Fig. 1. The Imperial 6-in. footpiece, Talbot 6-in. footpiece, and Talbot 8-in. footpiece, all of which were unsatisfactory in one way or another, owing principally to the constricted openings for admitting air to the eductor column, which at considerable lifts caused excessive back pressure, have been tried at Charcas (see Fig. 5). One of these footpieces choked in the small air openings and caused a back pressure of 25 lb. gage as compared with the Charcas footpiece. Experience led to the conclusion that the best footpiece is one of simplest design, with no choking back of the air or attempting to break it into fine streams. Apparently the theories advanced along the line of breaking the air into minute particles are without practical foundation.[3]

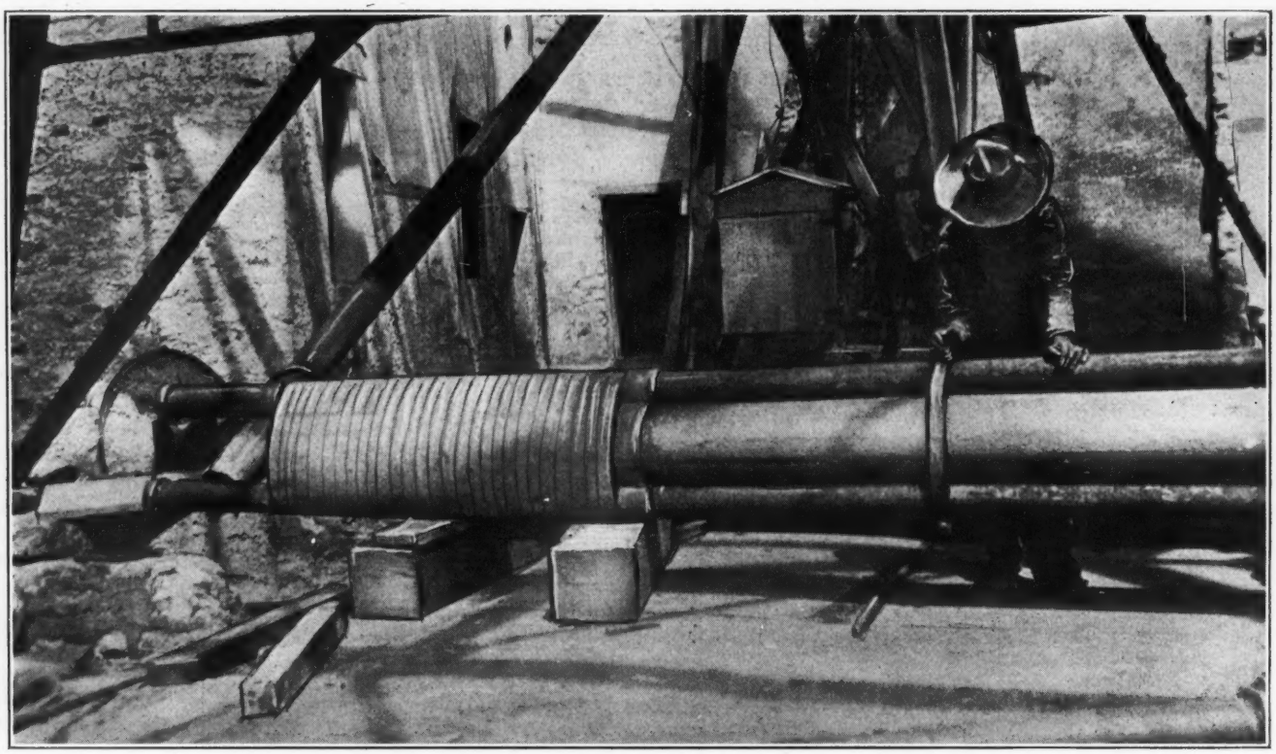


FIG. 2. TALBOT 8-IN. FOOTPIECE USED AT TIRO GENERAL MINE

It was considered best to make a footpiece of greater diameter than the first pipe to which it was connected, but in the case of No. 5 air lift, 7-in. pipe would have been used instead of 8-in. had there been in stock any 7-in. pipe. It was thought there should be ample area for all the water to enter the footpiece and become mixed with the air that could be accommodated in the 6-in. diameter pipe connected to the footpiece; hence the larger diameter of footpiece than of first length of water pipe.

Headpiece—The headpiece consists of a wooden tub, 42 in. in diameter and 36 in. in depth. A 10-in. hole is cut in the bottom of the tank, the water passing through a nipple 10 in. diameter and 26 in. long which is bolted to the bottom of the tub on the inside, thus discharging the water 26 in. above the bottom of the tub. The last length of 10-in. water discharge pipe is bolted through its flange direct to the 10-in. hole in the bottom of the tub. A deflector is securely fastened

[3] "Pumping by Compressed Air," p. 150.

by long bolts 32 in. above the bottom of the tub, which diverts the water outward toward the side and bottom of the tub. See Fig. 6. A 12-in. pipe is bolted to the tub on the outside and near the bottom, through which the water is carried to the measuring box. See Figs. 1 and 6.

It is most important from the standpoint of efficiency that the water column be perpendicular, and that there be no elbow or other obstruction at the end of the water discharge pipe. The air should be allowed to separate from the entrained water as soon as it issues from the top of the water discharge. The deflector facilitates this separation. An elbow at the end of the discharge, with one or more lengths of pipe attached, to convey the water to some desired point, will reduce the efficiency in a most marked manner.

Measuring Box—The measuring box, which contains a V-notch weir, is 36 in. wide, 37 in. deep, and 10 ft. 4 in. long. See Fig. 6. There are three baffles behind the weir to break up eddy currents. A diagrammatic sketch is shown in Fig. 1. The box is provided with a Sanborn automatic registering meter, which serves to provide fairly approximate measurements and gives a faithful record of the time that the water is flowing.

Carrier—The lower 626 ft. of the lift is suspended from the floor of a skip frame, the upper 725 ft. resting on the floor. See Fig. 4. A sheave wheel is attached to the clevis of the carrier around which the cable is passed, one end of the cable being fastened to the headframe. The other end of the cable is carried over the headframe sheave and fastened to the drum of a Wellman-Seaver-Morgan geared 225-hp. hoisting engine. The cable was doubled in this manner to divide into two parts the weight to be carried by the cable, and also to reduce to one-half the weight to be handled by the hoisting engine when lowering or raising the air lift.

Installation—The portion of the air lift below the carrier was made up at the collar of the shaft and lowered one length at a time into the compartment, using clamps to hold the pipes while the hoisting cable was being changed to the top of the last length. The carrier was placed in the shaft at a point on the pipe column where there would be sufficient cable to make up the two lengths needed to extend from the headframe to the carrier sheave and back to the hoisting engine. The portion of the pipe column above the carrier floor was added length by length as the carrier was lowered by the hoisting engine. The pipe columns were held

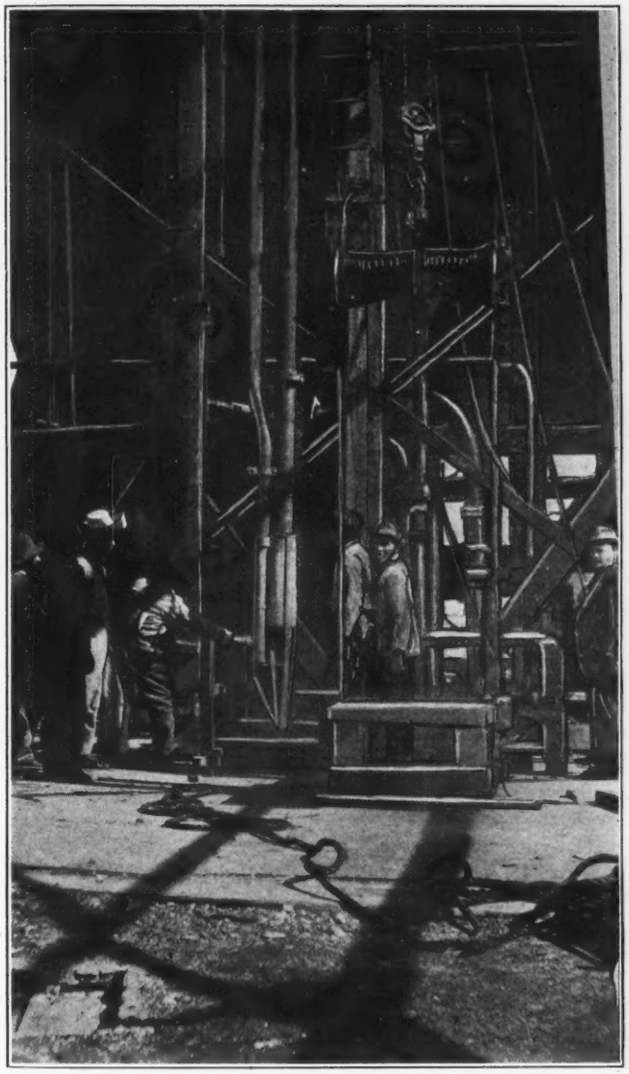


FIG. 3. MAKE-UP OF AIR AND WATER COLUMNS AT FOOTPIECE, USING 6-IN. TALBOT FOOTPIECE

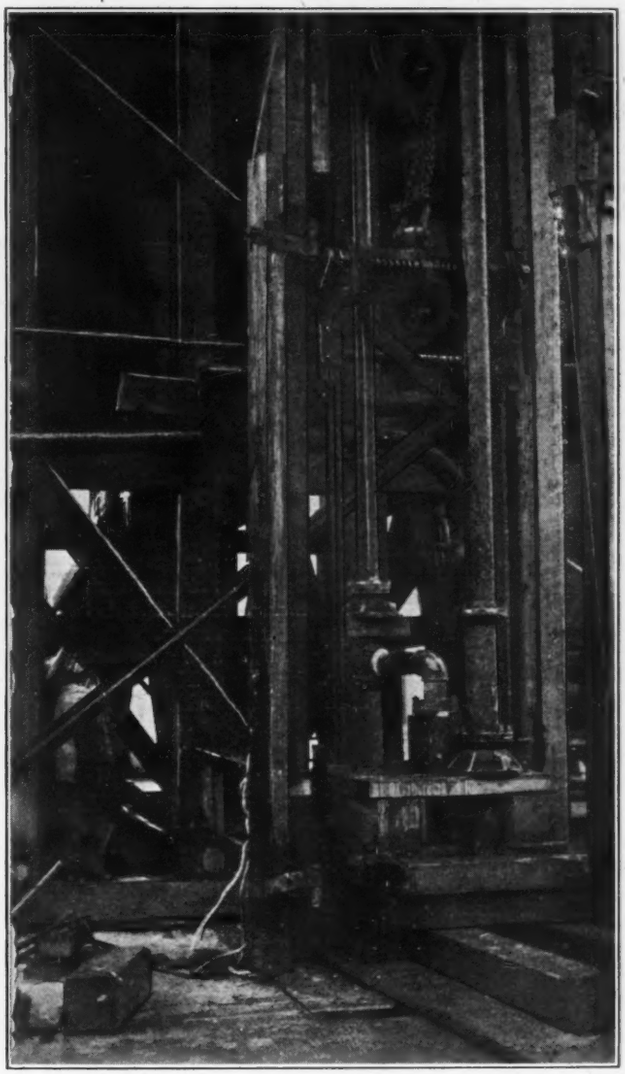


FIG. 4. METHOD OF SUPPORTING PIPE COLUMNS ON SKIP CARRIER

rigidly above the carrier by means of wood clamps, at each end of which the cable passed through a hole, and on the sides of which the air and water pipes were fastened by U-bolts. See Fig. 1. The time required in making up the air lift above the carrier was much less than that below the carrier, owing to the facility with which the entire length could be handled by the hoisting engine.

Operation of No. 5 Air Lift

The normal mine drainage had been reduced to about 200 gal. at the time the air lift was installed, and within six weeks had been reduced to about 175 gal. per min. The water was held approximately 10 ft. below the 1,050-ft. level, being raised direct to the surface, the lift then being approximately 1,080 ft., with submergence of 252 ft. It was desired to inspect the shaft timbers below the 1,050-ft. level, and the station at the 1,150-ft. level; therefore, the compressors were speeded up and the water was lowered to 1,125 ft., where another 30-ft. length of 10-in. pipe was added. The water was then lowered to the 1,150-ft. level, the lift at this point being approximately 1,170 ft., with submergence of 183 ft. So far as my knowledge extends, this was a greater lift, with much less submergence and raising a much greater quantity of water, than any air-lift work that had previously been done.

Tests were made on this air lift and tabulated as in Table I. Curves were drawn to determine the most efficient capacity of the air lift. Table I also includes comparative results of test made by E. M. Ivens on an air lift in oil well No. 32 of the Crowley Oil & Mineral Co., at Evangeline, La.[3]

After lowering the water to the 1,050-ft. level, the mine drainage was handled by a Jeansville 6 x 12 x 6-in. duplex plunger pump, driven by compressed air. The water was raised from the 1,050-ft. level to the 850-ft. level, whence it was pumped to the surface by the Worthington triple-expansion steam pump. The covering on the steam pipe had been removed and destroyed by being under water, and leaks had developed in the water column, and it became necessary to repair these lines. To do this, the use of the steam pump was discontinued because of the excessive amount of steam and moisture in the pipe compartment caused by the water dripping down on the steam line and making it impossible to work in the pipe compartment under these conditions. In the meantime, the obstruction below the 1,050-ft. level was removed, and it became possible to extend the air lift as described at the beginning of this article and to make use of it for handling the mine drainage during the period that the pipe columns were being repaired. With the steam pump operating under the unfavorable condition just mentioned, in which the loss of steam due to condensation was excessive, a fair comparison could not be made as to relative consumption of fuel when using the steam pump and when employing the air lift. Taking the conditions, however, as they existed, the consumption of fuel oil in operating the steam pumps was approximately 50 per cent greater than when using the air lift.

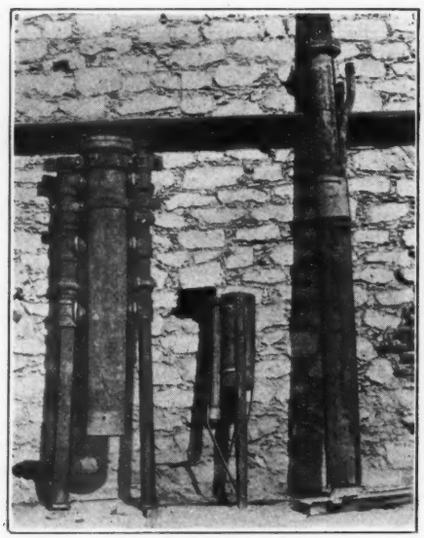


FIG. 5.

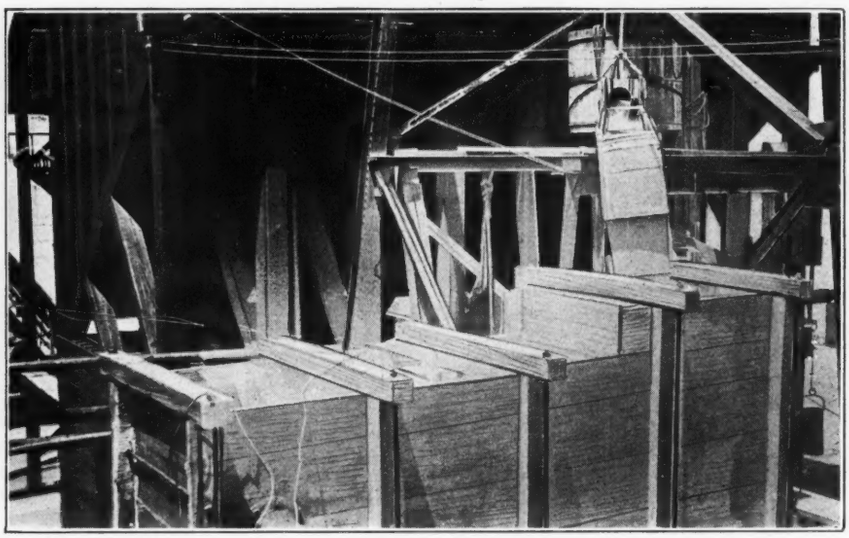


FIG. 6.

Fig. 5—On the left is the 8-in. footpiece in use at Tiro General Mine on No. 4 air lift; middle is Talbot footpiece, and right is Imperial footpiece. Fig. 6—Headpiece and measuring box of No. 5 air lift used at Tiro General Mine.

Advantages of Air Lift

The air lift possesses the great advantage that the entire operations are controlled from the surface, where an efficient installation of compressor can be made. No pumpmen are required in the mine. There is no warm air issuing from the shaft to cause rapid deterioration of shaft timbers. There is no danger of losing pumps in the event of the power failing at any time; when the power comes on again, the air lift can be started from the surface, thus causing no particular annoyance other than from the water rising into the workings, which obtains whatever may be the method of handling the water.

TABLE I. DATA ON TESTS ON TIRO GENERAL AIR LIFT NO. 5

	Test No. 1	Test No. 2	Test No. 3	Test No. 4	Test No. 5	Test by Ivens
Submergence (5) in feet	225	232	189	183	176	377.5
Lift (l) in feet	1,097	1,090	1,133	1,139	1,176	1,135.5
Total length pipe	1,322	1,322	1,322	1,322	1,352	1,513
Ratio S/L	20.5	21.3%	16.7%	16.1	15.0	33.2
Submergence, per cent	17.0	17.5	14.3	13.8	13.2	25.0
Cu.ft. free air at 7,250 ft.	2,050	1,910	1,950	2,061	2,510	.....
Cu.ft. free air sea level	1,614	1,504	1,536	1,623	1,976	573.5
Gallons water per min.	236	214	165	160	159	32
Cu.ft. free air per gal. (sea level)	6.84	7.03	9.37	10.14	12.42	17.9
Per cent pumping efficiency	31.2	29.7	25.1	23.7	20.3	11.2

[3] "Pumping by Compressed Air" p. 137.

It is my opinion that the exceptionally high costs of shaft sinking in very wet ground can be greatly lowered by sinking from the surface a bore hole of sufficient diameter and of sufficient depth to accommodate an air lift a short distance from the shaft and draining the water from the bottom of shaft to a point that is lower in the bore hole. The cost of the installation would soon repay the outlay in the saving to be made in sinking the shaft, in addition to the much greater speed that could be made in shaft sinking under these conditions. In unwatering mines, the air lift possesses advantages probably unequaled by any other method of pumping, provided sufficient submergence can be obtained.

Design of Air Lifts

Efficient design of air lifts for considerable depths is not easily made, owing to the almost total absence of data under these conditions. Fig. 8, taken from the paper "Unwatering the Tiro General Mine by Air Lift,"[1] is an approximation of the capacities of pipes of various diameters and of uniform diameter throughout, with submergence of approximately 215 ft. A change in submergence will change the position of these lines, but will not change the slope. As more data become available it is likely that the position of the lines will be changed somewhat. By the aid of this diagram it is fairly easy to determine the size of pipe of uniform diameter necessary to handle a given quantity of water with a given lift and a submergence of 215 ft. The theoretical quantity of free air (sea-level basis) required to raise one gallon of water to a given height is given in the formula:

$$X = 254 \log_e P_1 \text{ (for derivation see[1])}$$

where

- X *is the required number of cu.ft. of free air per minute;*
- L = *the height in feet to which the water is to be raised;*
- P_1 = *the absolute pressure in pounds per sq.in. at which the air enters the footpiece;*
- P_2 = *the absolute pressure in pounds per sq.in. at which the air leaves the headpiece. (At sea level this is about* 14.7 *lb. per sq.in.).*

[1] *Mining & Metallurgy*, No. 158, Sect. 35, February, 1920, p. 21.

Table II gives the quantity of free air required as calculated from the above formula for given lifts and submergences.

The efficiency at which an air lift will operate under given conditions is the most difficult figure to determine, and at present one is entirely dependent upon results that have been obtained under similar conditions. Table I gives the efficiency of No. 5 air lift, which, under the particular conditions obtaining, ranges from 20 to 31 per cent. It is my belief that by far the greatest loss in air-lift operations is that due to the friction of the moving air-water column. At the footpiece the velocity is not great, owing to the relatively small volume of the air due to the pressure under which it is admitted. At the headpiece the velocity had become very great, owing to the expansion of the air, especially in lifts of great height having considerable submergence.

The loss due to friction would appear to vary as the square of the velocity, but as the contents are an emulsion of air and water, varying in relative quantity as the mixture rises, the factor for friction loss is probably a variable, and would possibly require a complicated formula correctly to sum up the total loss. I have endeavored to work out such a formula, but the result was unsatisfactory, and have requested the aid of air-lift authorities, without attaining the desired information. Possibly this article may arouse sufficient interest to inspire the working out of a satisfactory formula.

TABLE II. QUANTITY OF FREE AIR, SEA-LEVEL BASIS, AT GIVEN PRESSURE THEORETICALLY REQUIRED TO RAISE ONE GALLON OF WATER TO GIVEN HEIGHT

Lift in Feet	46′ 20	58′ 25	69′ 30	81′ 35	92′ 40	104′ 45	115′ 50	127′ 55	138′ 60	150′ 65	161′ 70	173′ 75	184′ 80	196′ 85	207′ 90	219′ 95	230′ 100	242′ 105	253′ 110	265′ 115	276′ 120	288′ 125	300′ 130	311′ 135	323′ 140	334′ 145	346′ 150	357′ 155
10	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
20	0.09	0.08	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
30	0.14	0.12	0.11	0.10	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
40	0.18	0.16	0.14	0.13	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06
50	0.23	0.20	0.18	0.16	0.15	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08
60	0.28	0.24	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.14	0.14	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10
80	0.37	0.32	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.19	0.18	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.13
100	0.46	0.40	0.36	0.32	0.30	0.28	0.27	0.25	0.24	0.23	0.23	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.16	0.16
120	0.55	0.48	0.43	0.39	0.36	0.34	0.32	0.30	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.19
140	0.64	0.55	0.50	0.45	0.42	0.39	0.37	0.35	0.34	0.33	0.32	0.31	0.30	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.23
160	0.74	0.63	0.57	0.52	0.48	0.45	0.43	0.41	0.39	0.38	0.36	0.35	0.34	0.33	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26	0.26
180	0.83	0.71	0.64	0.58	0.54	0.51	0.48	0.46	0.44	0.42	0.41	0.39	0.38	0.37	0.36	0.35	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.31	0.30	0.30	0.30	0.29
200	0.92	0.79	0.71	0.65	0.60	0.56	0.53	0.51	0.49	0.47	0.45	0.44	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.35	0.34	0.34	0.33	0.33	0.32
250	1.15	0.99	0.89	0.81	0.75	0.71	0.67	0.63	0.61	0.59	0.57	0.55	0.53	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.45	0.44	0.43	0.43	0.42	0.41	0.41	0.40
300	1.38	1.19	1.07	0.97	0.90	0.85	0.80	0.76	0.73	0.70	0.68	0.66	0.63	0.62	0.60	0.59	0.58	0.56	0.55	0.54	0.54	0.53	0.52	0.51	0.50	0.50	0.49	0.48
350	1.61	1.39	1.24	1.13	1.05	0.99	0.93	0.87	0.85	0.82	0.79	0.77	0.74	0.72	0.70	0.69	0.68	0.66	0.65	0.64	0.63	0.61	0.60	0.60	0.59	0.58	0.57	0.56
400	1.84	1.58	1.42	1.30	1.20	1.13	1.07	1.01	0.97	0.94	0.90	0.87	0.84	0.82	0.80	0.79	0.77	0.76	0.74	0.73	0.71	0.70	0.69	0.68	0.67	0.66	0.65	0.65
450	2.07	1.78	1.60	1.46	1.35	1.27	1.20	1.14	1.09	1.06	1.02	0.98	0.95	0.93	0.90	0.88	0.86	0.85	0.83	0.82	0.80	0.79	0.78	0.77	0.75	0.74	0.73	0.73
500	2.30	1.98	1.78	1.62	1.50	1.41	1.33	1.27	1.21	1.17	1.13	1.09	1.06	1.03	1.01	0.98	0.96	0.95	0.92	0.91	0.89	0.88	0.86	0.85	0.84	0.83	0.82	0.81
550	2.53	2.18	1.95	1.78	1.65	1.55	1.47	1.39	1.34	1.29	1.24	1.20	1.16	1.13	1.11	1.08	1.05	1.04	1.02	1.00	0.98	0.96	0.94	0.94	0.92	0.91	0.90	0.89
600	2.76	2.38	2.13	1.94	1.80	1.69	1.60	1.52	1.46	1.41	1.36	1.31	1.27	1.24	1.21	1.18	1.15	1.13	1.11	1.09	1.07	1.05	1.03	1.02	1.01	0.99	0.98	0.97
650	2.99	2.57	2.31	2.11	1.95	1.83	1.73	1.65	1.58	1.52	1.47	1.42	1.37	1.34	1.31	1.28	1.24	1.23	1.20	1.18	1.16	1.14	1.12	1.10	1.09	1.08	1.06	1.05
700	3.22	2.77	2.49	2.27	2.10	1.97	1.87	1.77	1.70	1.64	1.58	1.53	1.48	1.44	1.41	1.37	1.34	1.32	1.29	1.27	1.25	1.23	1.21	1.20	1.17	1.16	1.14	1.13
750	3.45	2.97	2.66	2.43	2.25	2.12	2.00	1.90	1.82	1.76	1.70	1.64	1.58	1.54	1.51	1.47	1.44	1.42	1.39	1.36	1.34	1.31	1.29	1.28	1.26	1.24	1.22	1.21
800	3.68	3.17	2.84	2.59	2.40	2.26	2.13	2.03	1.94	1.88	1.81	1.75	1.69	1.65	1.61	1.57	1.53	1.51	1.48	1.45	1.43	1.40	1.38	1.36	1.34	1.32	1.30	1.29
850	3.91	3.37	3.02	2.75	2.55	2.40	2.26	2.15	2.06	1.99	1.92	1.86	1.79	1.75	1.71	1.67	1.63	1.61	1.57	1.54	1.52	1.49	1.47	1.45	1.42	1.41	1.39	1.37
900	4.14	3.56	3.20	2.92	2.70	2.54	2.39	2.28	2.19	2.11	2.04	1.97	1.90	1.85	1.81	1.77	1.73	1.69	1.66	1.63	1.61	1.58	1.55	1.53	1.51	1.49	1.47	1.45
950	4.37	3.76	3.37	3.08	2.85	2.68	2.52	2.41	2.31	2.23	2.15	2.07	2.01	1.96	1.91	1.87	1.82	1.79	1.76	1.72	1.69	1.67	1.64	1.62	1.59	1.57	1.55	1.53
1000	4.60	3.96	3.55	3.24	3.00	2.82	2.66	2.53	2.43	2.34	2.26	2.18	2.11	2.06	2.01	1.96	1.92	1.88	1.85	1.82	1.78	1.75	1.73	1.70	1.68	1.65	1.63	1.61

NOTE.—First row of figures are submergences and second row air pressures in pounds per square inch required.

To reduce the analysis of air-lift design to a point easier to understand, let us take a concrete example. Suppose the quantity of water to be raised is 2,000 gal. per min. and the height is 500 ft. Submergence obtainable is 215 ft. or greater; altitude, 5,000 ft. Required, the size of water pipe to install and the size of the compressor plant.

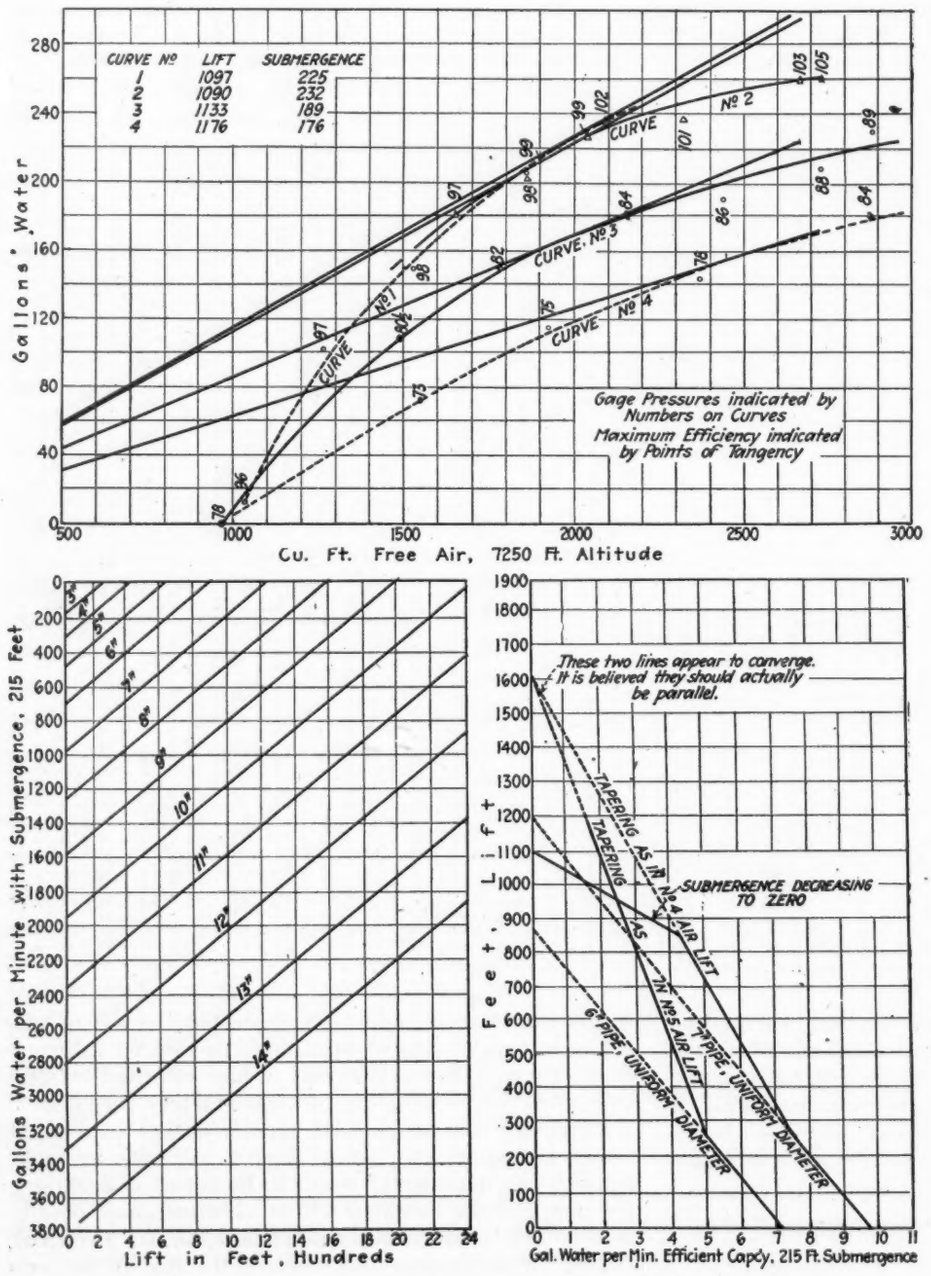
By reference to Fig. 8, it will be seen that a pipe of uniform diameter of 11 in. will be the most efficient in handling this quantity of water. Table II gives 0.99 cu.ft. free air as the theoretical quantity of air required per gallon with submergence of 215 ft. and lift of 500 ft. At a 500-ft. lift and submergence of 215 ft., the efficiency of a pipe of 11-in. diameter should be between 45 and 50 per cent. Assume 45 per cent. The quantity of free air (sea-level basis) per gallon of water is then

0.99 ÷ 0.45, or 2.2 cu.ft. The total quantity of air required to raise 2,000 gal. 500 ft. is 2.2 × 2,000, or 4,400 cu.ft. The quantity of free air at 5,000 ft. altitude at 100 lb. pressure that is equivalent to 1 cu.ft. at sea level is 1.182 cu.ft.; therefore, the quantity of air required in this instance is 4,000 × 1.182, or 5,200 cu.ft.

Under usual working conditions, it is probable that the compressor will have a volumetric efficiency of approximately 85 per cent; therefore, the displacement of the compressor under these conditions would be 5,200 ÷ 0.85, or 6,114 cu.ft. In other words, to raise 2,000 gal. of water per minute to a height of 500 ft. with submergence of 215 ft. and at an altitude of 5,000 ft., a compressor will be required having a displacement of approximately 6,100 cu.ft. of free air.

It appears probable from my experience that a pipe of diameter that increases as it extends toward the headpiece is more efficient than one of uniform diameter. Under the conditions above mentioned I would allow 5 per cent greater efficiency for a tapering pipe, and would start with a pipe of 10 in. diameter, increasing to 12 in. at the top. The total length of pipe line is 715 ft., which could be divided into three equal lengths, allowing, say, 235 ft. of 10-in. pipe, 240 ft. of 11-in. pipe, and 240 ft. of 12-in. pipe.

Fig. 9 indicates the approximate capacity to two pipes tapering from 7 in. to 10 in. and from 6 in. to 10 in., as determined at the Tiro General Mine. Further work will indicate whether these lines should be moved slightly to the left or right.


CURVE Nº LIFT SUBMERGENCE
1 1097 225
2 1090 232
3 1133 189
4 1176 176
Gallons Water
Cu. Ft. Free Air, 7250 Ft. Altitude
Gage Pressures indicated by Numbers on Curves
Maximum Efficiency indicated by Points of Tangency
CURVE Nº 2
CURVE Nº 3
CURVE Nº 4
Gallons Water per Minute with Submergence, 215 Feet
Lift in Feet, Hundreds
These two lines appear to converge. It is believed they should actually be parallel.
TAPERING AS IN Nº 4
SUBMERGENCE DECREASING TO ZERO
AIR LIFT
6" PIPE, UNIFORM DIAMETER
7" PIPE, UNIFORM DIAMETER
Feet Lift
Gal. Water per Min. Efficient Capcy. 215 Ft. Submergence

FIGS. 7, 8 AND 9. CAPACITY AND AIR CONSUMPTION BY AIR LIFTS

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Fuller's Earth

Fuller's earth obtains its name from its original use in fulling cloth, but only a little domestic earth is now used in this country for that purpose. It is used principally in bleaching and in clarifying or filtering fats, greases, and oils. It is also used in the manufacture of pigments for printing wallpapers, and in detecting certain coloring matters in some food products.

Diesel Engines Under High Altitude Conditions

Pressure in Cylinders May Be Considerably Reduced And Still Obtain the Same Temperature at the End of Compression as at Sea Level

BY THEODORE M. ROBIE
Written for *Engineering and Mining Journal*

THE effect of altitude on internal-combustion engines is a subject about which little is known, and as a large number of these engines are giving service in mining districts thousands of feet above sea level, the subject should be more thoroughly understood by those who use this mode of power.

The following incident occurred some years ago while I was operating a Diesel engine at an altitude of 6,200 ft.: A visitor was looking the plant over, and among other questions he asked what compression pressure was being used. I answered, "About 400 lb." "Why," he said, "I don't see how you can get satisfactory combustion. I have always understood that 500 lb. was required for Diesel engines." I then explained to him that the temperature at the end of compression up to 400 lb.

INDICATOR CARD FROM A DIESEL ENGINE

per sq.in. at 6,200 ft. elevation is practically the same as the temperature at sea level with 500 lb. per sq.in. compression.

The engine I was working on at this time was a 17½ x 28 twin horizontal, running at 200 r.p.m. and having a sea-level rating of 250 hp. The illustration is an indicator card taken from this engine, with a 400-lb. spring. At the point b, having a pressure P_b and absolute temperature T_b, the compression curve starts, ending at the point c, having a pressure P_c and temperature T_c. This notation will be used in the following discussion.

Assume that this engine operated at the factory at sea level with a compression pressure of 500 lb. per sq.in. The amount of compression at 6,200 ft. elevation may be found as follows: Let x be the volume of the compression space in cu.in. This being a four-stroke-cycle engine the assumption may be made that the cylinder is filled with pure air, as the amount of burned gases remaining therein at the end of the exhaust stroke is small. This being the case, the formula for adiabatic compression will then hold;

$$P_b\ V_b^{1.402} = P_c\ V_c^{1.402} \qquad \text{(I)}$$

The piston displacement is,

$\frac{\pi\ d^2}{4} \times s$, *where d is the cylinder diameter, and s is the stroke, or*

$$\frac{\pi \times 17.5^2}{4} \times 28 = 6{,}735\ \textit{cu.in.}$$

Then, if the pressure at the start of the compression stroke is assumed to be atmospheric, from equation I,

$$14.7\ (6{,}735 + x)^{1.402} = 500\ x^{1.402} \qquad \text{(II)}$$

or,

$$(6{,}735 + x)\ \sqrt[1.402]{14.7} = x\ \sqrt[1.402]{500} \qquad \text{(III)}$$

$$6.79\ (6{,}735 + x) = 84x \qquad \text{(IV)}$$

$$45{,}750 + 6.79x = 84x \qquad \text{(V)}$$

$$x = 592\ \textit{cu.in.} \qquad \text{(VI)}$$

The theoretical compression for an altitude of 6,200 ft. may now be determined.

The following table gives the pressures corresponding to elevations from 1,000 to 10,000 ft. above sea level:

TABLE I. PRESSURES CORRESPONDING TO ELEVATIONS

Altitude in Feet	Inches of Mercury	Pounds per Sq. In.
1,000	28.88	14.20
2,000	27.80	13.67
3,000	26.76	13.16
4,000	25.76	12.67
5,000	24.79	12.20
6,000	23.86	11.73
7,000	22.97	11.30
8,000	22.11	10.87
9,000	21.29	10.46
10,000	20.49	10.07

From the above P_b will be seen to be approximately 11.65 lb. per sq.in. at an altitude of 6,200 ft.

Substituting in equation I,

$$11.65\ (6{,}735 + 592)^{1.402} = P_c\ (592)^{1.402} \qquad \text{(VII)}$$

$$11.65 \times 262{,}196 = 7{,}635\ P_c$$

$$P_c = 402\ \textit{lb. per sq.in. compression at 6,200 ft.}$$

This value coincided very closely with the values obtained with the indicator.

Having determined these, the matter of temperatures may now be considered. From the fundamental equations of thermodynamics,

$$\frac{T_c}{T_b} = \left(\frac{P_c}{P_b}\right)^{\frac{y-1}{y}} \qquad \text{(VIII)}$$

where y is 1.402. The new charge of air will receive considerable heat from the cylinder walls, so that it will be safe to assume an initial temperature of 110 deg. F. As the temperature values in equation VIII are absolute, 459.4 must be added to this, giving,

$$T_b = 569.4\ \textit{degrees absolute.}$$

Then for sea level, with a compression pressure of 500 lb. per sq.in.

$$T_c = \left(\frac{500}{14.7}\right)^{\frac{1.402-1}{1.402}} \times 569.4 \qquad \text{(IX)}$$

$$= 34^{0.287} \times 569.4 = 2.751 \times 569.4$$

$$= 1{,}567\ \textit{degrees absolute.}$$

$$1{,}567 - 459 = 1{,}108\ \textit{degrees F.}$$

And for 6,200 ft. altitude, with its corresponding compression pressure of 402 lb. per sq.in. and atmospheric pressure of 11.65 lb. per sq.in.,

$$T_c = \left(\frac{402}{11.65}\right)^{\frac{1.402-1}{1.402}} \times 569. \qquad \text{(X)}$$

$$= 34.5^{0.287} \times 569.4$$

$$= 2.764 \times 569.4 = 1{,}575\ \textit{degrees absolute.}$$

$$1{,}575 - 459 = 1{,}116\ \textit{degrees F.}$$

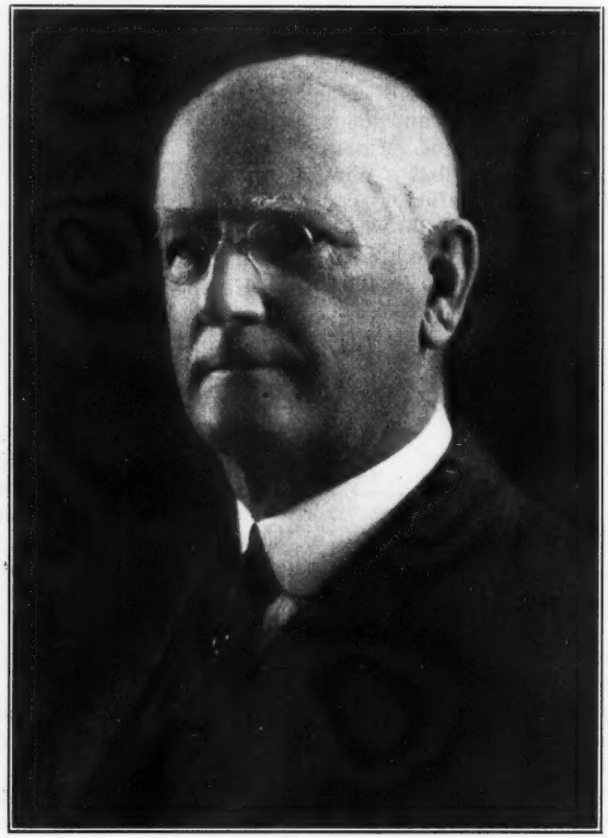
Thus, at high altitudes it is not necessary to use the same compression as is used at sea level, in order to get the same temperature at the end of compression.

Manganese Deposits in Costa Rica are found at several places on the Nicoyan peninsula, in the Province of Guanacaste, according to the U. S. Geological Survey. Other isolated deposits occur in the eastern part of the peninsula, near the Gulf of Nicoya. Although deposits of manganese oxides were examined at thirty-six places near Playa Real, most of the ore shipped has been derived from three deposits that lie in an area scarcely 1,000 feet square at Playa Real. These deposits are owned by the Costa Rica Manganese & Mining Co., an American company. The deposits in Panama lie in an inaccessible region along Boqueron River, about twenty miles northeast of Colon. They are about twelve miles southwest of the deposits at Nombre de Dios, which were extensively explored from 1871 to 1902.

Prominent Men of the Mining Industry

William Kelly

FORESTRY, road building, and the education of mining engineers are the principal amusements of William Kelly, of Vulcan, Mich., general manager of the Penn Iron Mining Co. So he will tell the inquirer, although *Who's Who* mentions only automobile driving and golf. Mr. Kelly is chairman of the board of control of the Michigan College of Mines and also president of the board of education of Norway Township, on the Menominee Range. He inherits his taste for educational matters, his father, Robert Kelly, having at one time been president of the board of education of New York City, regent of New York University, and president of the board of trustees of Rochester University, and many of the younger engineers of the day know through personal experience in what way he has indulged this taste. Kelly and calculus are intimately associated in the minds of the students at Houghton, who once a year are put to it to solve a problem in calculus applied to mining sent up from Vulcan. But this is only one side of the man. Kelly has been with the Penn Iron Mining Co. since 1889, when he began as superintendent. He was educated at Yale and the Columbia School of Mines, taking his E.M. at the latter in 1877. From this time until he went with the Penn company he was connected with several iron companies in Pennsylvania, principally as superintendent or in other executive capacity. From 1902 to 1914 he was also general manager of the Republic Iron Co. on the Marquette Range.



WILLIAM KELLY

Today engineers are being censured for their failure, in general, to take a more active part in public life. Con Kelley, president of Anaconda, recently denounced this sweeping accusation as false, and possibly he had his namesake on the Menominee Range in mind. It is hard for one with the name of Kelly to remain obscure, and "Bill" Kelly has been prominent in the various phases of life in northern Michigan.

From 1885 to 1889, he was president of the board of examiners of the bituminous mine inspectors of Pennsylvania. In 1897 he became a member and since 1904 has been chairman of the board of control of the Michigan College of Mines, as before stated, and he has been president of the board of education at Norway since 1903. He has been chairman since 1904 of the board of county road commissioners of Dickinson County, Mich., and for the last year has been a member of the state highway advisory board. In 1905, he became a director, and since 1910 has been vice-president, of the Commercial Bank at Iron Mountain, Mich. In 1916, Mr. Kelly was a delegate to the National Republican Convention. He was president of the Lake Superior Mining Institute in 1899-1900, and past councillor from 1910 to 1912. At present he is chairman of the A. I. M. E. committee on the use of electricity in mines. During the war he was active as chairman of the local Red Cross Chapter and Liberty Loan Committee. For the last eleven years, Mr. Kelly has been on the public domain commission of Michigan and he has been its chairman since 1917. This commission has in charge about 600,000 acres of land which has reverted to the state for non-payment of taxes. Of this acreage, nearly half is under active management in nine forest reserves.

Mr. Kelly is a member of numerous technical and scientific societies and of the University clubs in New York and Chicago. He has contributed several papers to the *Transactions* of the A. I. M. E., and to the *Proceedings* of the Lake Superior Mining Institute. He is still young, though sixty-six years old, having been born in 1854 in New York City, where his grandfather, Robert Kelly, had settled on coming here from Ireland. Kelly is a Presbyterian. In 1886, he married Annie Ashcom, daughter of Charles Wesley Ashcom, who was the founder of Hopewell, Pa., and justice of the peace there.

William Kelly has won a prominent place for himself among his fellow men, and this is due as much to his kindly personality, and to his willingness to serve the public in many capacities, as to his achievement as an executive.

By The Way

A Transatlantic Toss

Sir Auckland Geddes, the British Ambassador, in a speech at the Pilgrim's dinner held in New York recently, denied that Great Britain is seeking to monopolize the world's fuel-oil supply. Referring to reports that his government was trying to pool the war debts of Europe and to drag the United States into the pool, the Ambassador said: "You may seek far and wide for evidence on which that statement could be based. You will not find it. If you look closely you will find my government trying to pour oil on the troubled waters of Europe and you will also find onlookers who seize the oil as it is poured and throw it on the fires of anti-British feeling here."

Some throw, Sir Auckland, we are impelled to remark. However, the metaphor is perfect.

The Noblest Work of God

An honest man, said the poet, is the noblest, etc. We do not know the name or the address of the claimant under the War-Minerals Relief Act who wrote the letters below, but they are as refreshing to us as a blast of mountain air. A man with sound sense, the instinct for impartial justice, and the saving sense of humor, the writer represents for us the best American type.

War Minerals Relief Commission,
Washington, D. C.

Gentlemen: Your letter of May 6th inclosing the recommendation of your commission in the matter of our claim for relief under act of March 2, 1919, is before me, and I thank you for an opportunity for comment. Our views on this matter are pretty well stated in a reply to a so-called law firm in Washington asking to represent us before the Court of Claims, a copy of which I inclose, to which court he thought our claim would be assigned for adjudication.

Under the law, as worded, it is hard to see how the Attorney General could rule otherwise; but the law which called for such a ruling is a humbug and should never have been enacted, for the following reasons . . .

So self-interest and patriotism both impelled us not only to mine known deposits but go out and hunt others and supply the demand. Now, the same law (of supply and demand) which speeded up the mineral production was felt in all other basic products; hence it was a bad law and against public policy to make "fish of one and flesh of another" after close of hostilities. But the discrimination in this case was even worse, for the law not only discriminates in favor of certain minerals, but selects certain firms and individuals already engaged in production, as the beneficiaries of an $8,000,000 appropriation, as against those who went in to supply the demand, discovered and opened new mines, and met, or prepared to meet, the emergency, with far greater risk of loss than those who were already in the business and had only the risk of oversupply to encounter—which risk finally overtook all alike. Hence, any law enacted for relief should have been so drawn as to be fair to *all* interests involved; but it should have never been on the statute books in any event.

So this was somewhat the spirit in which we were taking hold of this manganese proposition: One must be able to show prospective profit in these things or capital cannot be interested; and, furthermore, these enterprises must realize enough to carry themselves, or they become, more or less, a dead weight on other producers. I have no doubt my associates felt pretty much as I did; but some felt that so long as the Government was generous enough to offer relief where losses had been sustained, we would state our case fairly and accept cheerfully any decision that might be made. Of course we saw the "joker" in the bill for relief, but took chances, much on the principle of the fellow accused by his friend of "drawing the long bow" when he stated he had seen buffaloes climb trees after grapes, and who replied that he knew that it is not generally understood that buffaloes climb trees, but when a buffalo is after grapes, the Lord only knows what he will do; and so with Congress in a Presidential year.

The reply made by the writer of the above to the Washington law firm follows:

Your favor of April 29, inclosing Amended Bill for Relief of Producers of War Minerals, is at hand; also your offer to look after our interest for a retainer of $25 and 20 per cent of recovery, is before us, for which we thank you.

In reply will say that your proposition does not appeal to us, for the following reasons:

Both the original bill of March 2, 1919, and the proposed bill (S. 4259), amending the same, are based on the fact of an existing contract or understanding with the U. S. Government, either direct or implied, by the claimant for the production of war minerals, etc. We had no such contract or understanding and so stated in our papers, and on these papers we must be judged in any court. But, assuming that our claim was entirely just, and that we had a contract with the Government, which for some reason had been ruled out—by those administering the act of March 2, 1919, the so-called amendment provides no relief except in *words:* for it is generally understood by the public that the U. S. Court of Claims, to which it would be assigned, is merely the limbo to which Congressmen send claims of persistent constituents, well knowing that to be the last of them, and the said constituent may thereby also have the grim satisfaction of being a man who has a *claim against* the Government, which he can pass on down to his descendants, and gives him the excuse also to pat his Congressman on the back and vote for him as long as said Congressman is available. No—we want none of this nonsense, and feel quite sure our so-called claim was very properly ruled out under the law.

In Jail and Out

Housing accommodations throughout the country are not altogether as bad as in certain parts of the metropolis. Randsburg, Cal., recently advertised its jail for sale, owing, it is said, to prohibition. On the other hand, at Pecos, Tex., in the oil district, it is reported that from ten to a dozen men have been sleeping in the county jail for want of something better.

Inexperience

"About the strangest mining I ever saw," observed an old mining man, "was in the Cave Creek district, in Arizona, where two nice young college fellows from the East had started a tunnel into a fragment from the hillside, one that had been detached with its section of a decent-looking ledge and that had become deeply imbedded in the sands of the creek bed. The boys showed me the tunnel with deep pride. It was on the level of the dry creek, with a bit of pitch downward that would have struck the sand very soon. But they were nice lads, and they gave me butter with the lunch they cooked, so I didn't dampen their enthusiasm."

In the Good Old Days

There were mines of gold and silver on the Island of Siphnos, one of the Cyclades, in the Ægean Sea, according to Herodotus, that were of so rich a yield that "from a tithe of the ores the Siphnians furnished a treasury at Delphi which was on a par with the grandest there. What the mines yielded was divided year by year among the citizens."

CONSULTATION

Mining Law Defects

"I am interested in the mining law, and if it is possible for you to inform me concerning any articles written on this subject, especially those relating to defects and proposed remedies, I would be under a great obligation for the information furnished."

The revision of the mining law has occupied the attention of some of the country's foremost mining engineers, and from the nature of your inquiry we take it you are more interested in articles on proposed changes in legislation than in the text of the various measures themselves, for many volumes have been published on American mining law which discuss the technicality of the legislation and the decisions that have been reached in litigation. "Lindley on Mines" is an exhaustive treatise of this character. There is an excellent summary of the mining laws of the United States in Peele's "Mining Engineers' Handbook," written by an authority on the subject and a mining engineer of note, Horace V. Winchell.

Valuable articles on the defects and proposed remedies of the mining legislation in this country have appeared in the *Transactions* of the American Institute of Mining Engineers during the last few years. The most important of these from the standpoint of constructive legislation is Horace V. Winchell's article, "Why the Mining Laws Should Be Revised," which appeared in Vol. 48, pp. 365 et seq. of the *Transactions*. This article is an excellent digest of the opinions of some of the most prominent mining engineers in the country on mining law revision, and well worthy of study in this connection. Other articles in the same volume, a good part of which was devoted to mining law are "Good Ideas in the Mining Law of British Columbia and Mexico," pp. 354-360, and "A Proposed Legislation in the Mining Law," pp. 405-418. Other important papers are, Courtney de Kalb's "Defects of the Mining Law," Vol. 51, pp. 284-290, and a description of admirable features of Canadian mining law, Vol. 42, pp. 614-623. Most of these articles contain discussions by other engineers that help to make them valuable contributions to the literature on the subject. All will amply repay consultation study.

Ilmenite

"The undersigned has received a letter of recent date from a friend who has been trying to mine ore for tin.

"He writes me that he has not found much tin, but has run across a lot of Ilemeue (this is as near as I can make out his writing), which he says is a mixture of titanium and iron oxides, and would like to find out its value if he can and the best place to have it assayed or reduced.

"He states that this titanium is combined in the oxide state with iron oxide FeO 18 per cent, TiO 38 per cent, in a loose attachment.

"The writer is not at all familiar with metals, and therefore does not know exactly how to undertake to give my friend the information, but a kind acquaintance has directed me to you. He is a subscriber to your journal and an investor in copper, and so I take the liberty of writing you, asking for any information you may give me on the subject of these two metals, their value, if any, and where my friend can send his samples for testing or assaying."

The mineral you refer to in your letter is undoubtedly ilmenite, commonly called titaniferous iron ore, the chemical composition of which is $TiFeO^3$ and which is found extensively in New York State. This mineral has little commercial application. As a source of iron, it is unimportant, for titanium-bearing slags from the smelting of ilmenite in the blast furnace are stiff and cumbersome. Under proper working conditions, however, it has been demonstrated that ilmenite will yield a pig iron of good quality when smelted in the blast furnace. Research has been made into utilizing the titaniferous iron ore resources of the country.

The titanium content of the mineral is applied to the manufacture of ferrotitanium or ferrocarbon titanium, two ferroalloys that are employed in the manufacture of alloy steels. The ferroalloy is generally manufactured in the electric furnace from ilmenite. In cases in which a considerable percentage of carbon is permissible, for instance where the alloy is required for the treatment of cast iron for high-grade carbon-steel, the mineral is reduced directly in contact with carbon in the electric furnace. Where a pure iron titanium alloy is desired, a process used extensively in this country is to charge the ilmenite into a bath of molten aluminum in the electric furnace. The mineral at once undergoes a chemical reaction whereby iron is formed, in which the titanium dissolves as the action proceeds.

Ilmenite commands a price of about $20 a ton, f.o.b. mines, for ore carrying 52 per cent TiO_2. If you desire to have your product assayed or analyzed, no doubt some of the advertisers in the columns of the *Engineering and Mining Journal* who perform this sort of work would be glad to do this for you.

If your friend has found tin, this metal commands a price around 50c. per lb., New York. The tin resources of the United States, in contrast to the wealth of other metals are woefully small, the known domestic tin deposits being almost negligible. A discovery of tin in commercially important quantities in the United States would be an unusual event.

Market Lead Terms

"I have frequently heard the term 'soft lead' and 'hard lead' applied to the lead market, and wish you would inform me of their significance."

"Soft lead" is a market term that is used, besides its physical sense, to designate lead that is almost entirely free from silver, a common associate of lead. The lead ores of the Mississippi Valley are of this character, whereas those of the Western United States usually contain appreciable quantities of the precious metals. As a general rule, the smelters running on soft lead ores do not desilverize their product. There are a few exceptions, the St. Joseph Lead Co. desilverizing some, and the St. Louis Smelting & Refining Co. desilverizing all its product. "Hard lead" contains numerous impurities, that, if not inherent in the metal as it comes from the smelter, are added to increase its hardness. Such impurities are antimony and arsenic.

THE PETROLEUM INDUSTRY

Geological Jazz

SOME sins are committed in the name of geology, but the following specimen sounds to our ears like a "jazz" band in a college fraternity house. The war complex, and the succeeding readjustment jangle, are responsible, no doubt, for a lot of bizarre thought on the part of some who may not have done much thinking before.

Real values in thought, as in acreage, are perhaps difficult to discover in the aurora that attends the opening up of a new oil field. Hopeless optimism sometimes prevails. Away from the area of hope and in the centers of commerce and the offices of statisticians there has been evidence of a pessimistic conviction that the petroleum industry is going into a rapid decline. Along with the increasing demands of the insatiable auto, motor truck and tractor, the impending shortage in domestic supply is emphasized, and we must confess that the figures of consumption and output are not encouraging.

In the midst of this gloom it cheers us immensely to find an optimist who is brave enough to tell us that our petroleum and coal supply can never be exhausted. We present this choice specimen which a friend of ours has clipped from a paper called "Opportunity," and leave our readers to reach their own conclusions:

That petroleum and coal are the products of constant and continuous chemical combinations taking place in the bowels of the earth, and that these processes are now going on as they have through all the ages, and that on that account petroleum and coal are and will be produced through all time, and therefore never can be exhausted, is the interesting theory of C. W. McKinney, geologist, Dallas, Tex., as set forth in a recent contribution to the *Texas Oil Ledger*. He says:

"It is claimed by many of the most eminent geologists that petroleum and coal and gas would in time be a thing of history, from the fact that their origin is from the decomposition of vegetable and animal matter.

"I shall endeavor to set forth the fact that petroleum and gas will continue in its creation as long as time lasts, just the same as it has been created in past ages. I shall begin my theory with the waters of the earth as the first element in the possible origin of petroleum and coal (bituminous coal), with the intense heat in the earth, water coming in contact with the heat, which then turns to steam.

"You will very readily understand that the steam is decomposed, the oxygen being consumed, and the hydrogen set free.

"The hydrogen, coming in contact with the different rocks and formations of the earth, forms gas. This steam and gas is continually being produced by water and heat, and as steam occupies 1,700 times the space of any given quantity of water, you may expect this pressure to force its way through the many seams, cracks and fissures that are in the earth, and as it seeks its outlet through these seams and fissures, the gas becomes thicker; as it gathers the different elements as it passes through the earth, it becomes carbonized, and then we have petroleum.

"Then after many ages of time that we cannot pass upon, this petroleum being forced through these fissures finds itself a lodging place somewhere in the earth as a reservoir—the final end of its journey; which brings us up to the coal veins. This liquid, petroleum, then becomes solidified, and is in veins of bituminous coal.

"If my theory is correct, bituminous coal is solidified petroleum. Now, will some geologist tell us why coal is in veins, but not in great bulky masses of vegetable matter, as peat is found?

"Coal, like petroleum, is composed of hydrogen and carbon. Peat is undoubtedly a vegetable composition, and is found in great bulky deposits, where the vegetable matter fell and was dried out, and again both peat and wood are converted by heat into charcoal, while all coal under heat makes coke, and cannot make charcoal, and again you cannot make coke from peat or wood.

"Geology has never been able to explain why all coal measures lie in veins, rather than in great bulky masses, as would have resulted had the vegetable decomposition theory been true.

"I conclude with this theory as the possible origin of petroleum and coal. If coal was not in liquid form at some stage of its origin, how did it get in veins as we find it in the coal mines?"

Barrel Costs Vs. Well-Day Costs*

BY ROSWELL H. JOHNSON AND A. W. FOSTER

AN OIL property is appraised by determining the net returns from the product and salvage, less costs and interest and allowance for risk. If the acre-yield method is used for appraising, the history of a district is used as a basis of comparison for similar properties in the same district where conditions are thought to be comparable. From this history, barrel costs (costs per barrel produced) as well as acre yield (barrels produced per acre) are available, and a flat-rate barrel cost averaged for the whole life may be determined and used. But where a property is appraised by the annual method, net annual returns are computed for a period of years by multiplying net production for each year by net-barrel income for that year and then multiplying by the compound discount factor for that year to find the present worth of each year, and, finally, totaling the present worth values and the discounted salvage value.

Under these circumstances a flat barrel-cost rate, year to year, should not be assumed, for it cannot be the same through the life of the property, as wells increase in the cost per barrel as there are fewer barrels in the later history among which to divide the maintenance of the well. To assume such a flat rate throughout the life of the property will lead to gross error in the appraised value, an erroneous economic limit, and therefore incorrect estimate of life.

Costs per well-day (or costs per well-year) also change through a period of years, but are relatively constantly advancing (at a rate between 4 and 9 per cent per year in some cases that we have studied). They should therefore be used in preference to flat barrel costs, as the following evidence will show. Yet, as for purposes of calculation barrel-day costs are often needed, these can be calculated separately for each year by dividing the well-year costs of any year by the production of that year.

It is important that this fact be stated, as Bulletin 177 of the U. S. Bureau of Mines is being widely used, and it makes use in its valuation example of a flat barrel cost throughout the life of the property. In obtaining the data to demonstrate this point, another

*Presented at the Dallas Meeting of the American Association of Petroleum Geologists and published by authority of the council of the association.

matter of interest has developed. If the entire lease was drilled up early, then maintenance cost should regularly increase per well-year, although much less rapidly than barrel costs. The reason may safely be assumed to be an increase of wages and costs of supplies. The late installation of a power plant may, of course, entail a sudden decrease, in spite of the general advance. So far, for simplicity, what are called "operating costs" have alone been considered, and the proportion of general expense and taxes have been excluded. When the latter are added to the well-year cost, as should be done, two interferences arise—the wave of high taxes caused by the war and the fact that general expense (that portion chargeable to the old wells) is frequently reduced by the expense of the staff being divided over an increasing number of wells. This takes place when the company is an expanding one.

Some properties show a period of decline in well-year operating costs for a few years, followed by the slow advance. If the property comes in with small initial production per well, the advance will be caused by the extra labor necessitated until conditions become stabilized. But if the property has a large initial production per well, the increase of costs will usually be found to be due to the result of putting into expense what are really deferred-construction disbursements, a not uncommon practice.

The purpose of this paper is to urge that in annual appraisals based on the analytic method (and we believe this is much better than the less reliable acre-yield method, both for tax and sale purposes), the barrel cost should change with the year, being calculated each year from the well-year cost of that year.

Deposits of Oil Shale in Bulgaria

The most important oil-shale deposits in Bulgaria, according to a recent article in *Commerce Reports* by Graham H. Kemper, U. S. Consul at Sofia, are in the following localities:

Near Breznik.—These deposits are found about six miles north of the town of Breznik. Here occur sandy, clayish shales and limestone beds. Among the sandy deposits is included a bed about 150 ft. thick, formed of deposits of oil shale. According to the oil percentage in this bed it may be divided into three grades, one of which contains from 12 to 13 per cent of crude oil. The thickness of this layer is about 20 ft. The total amount of these shales is estimated to be 30,000,000 tons for the surface shale only. The deposits are about fifteen miles from the railway line.

Near Radomir.—The deposits here are found about five to seven miles west of the railway line Sofia-Batanovtzi-Radomir. These are graphite deposits and extend for a distance of about twelve miles.

Near Popovtzi.—These deposits are found along the railway line Stara-Zagora-Tirnovo, slightly more than one mile south of the station of Popovtzi. The soil here is composed of earthly layers in which the deposit of bituminous shales is found.

Near Kazanlik.—These deposits are found west of the town of Kazanlik, near the village of Saltikovo. They are similar to those found at Popovtzi.

Near Sirbinovo.—These deposits are found about nine miles south of the town of Gorna Djoumaya, near the village of Sirbinovo. The soil here is composed of earthy layers, in which are found deposits of bituminous shales together with layers of lignite. According to the investigations already made, the layers of shale appear to be about 80 ft. thick and the layers of lignite from 6 to 8 ft. thick. The shales which have been studied from this region were found at distances of from one to two miles of each other.

It would appear from the investigations that the shales found in Bulgaria are not inferior in their oil content to those found and exploited in Scotland, where at their best only 12 per cent of crude oil is yielded. It is said that during the war the industry of distilling oil from oil shale reached such a state of perfection in Germany that it was found profitable to distill shales yielding only 5 per cent of crude oil. The three concessions already granted for the production of mineral oil from oil shale are in the region of Sofia, Kustendil, and Vratza; in the Stara-Zagora district, and in the region of Gorna Djoumaya and Philippopolis.

Flow of Fuel Oil in Pipe Lines

BY W. H. THIES

Written for *Engineering and Mining Journal*

With the price of coal increasing almost daily, the attention of engineers is being directed to the use of fuel oil as a substitute. Despite the ever-prevalent rumors of the diminishing supply of this product, if a two or three years' contract can be closed for the delivery of oil at its present price it is considered a saving to adapt coal-burning boilers for burning oil for that period of time.

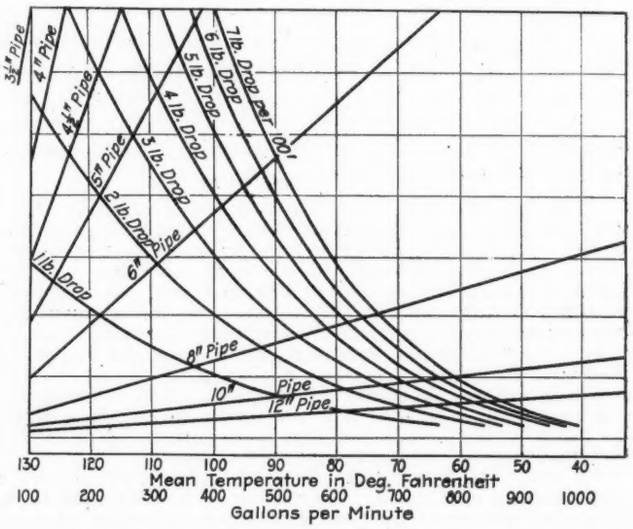


DIAGRAM FOR DETERMINING PIPE LINE DATA

The following formula has been derived from experiments made with Kern River crude oil, 15.2 deg. Bé:

$$P = \frac{318\,B}{\left(\frac{t}{100}\right)^4 \times D^{3.8}}$$

Where

B = *barrels of oil per hour.*

P = *friction loss per mile in pounds per square inch.*

t = *mean temperature of the oil in degrees Fahrenheit.*

D = *diameter of the pipe in inches.*

In order to save time, the accompanying curves will serve to determine directly, without computations, the quantity, friction loss, mean temperature or the pipe size required for fuel oil, any three of these factors having been given.

NEWS FROM THE OIL FIELDS

Oil Demands of Navy Large

Change of Power Equipment and Addition of New Oil-Burning Ships Increase Supply

From Our Washington Correspondent

Navy requirements for fuel oil for the next fiscal year will be in excess of 8,000,000 bbl., and this figure is in addition to the requirements of 2,621,000 gal. of lubricating oil, according to the estimate of Admiral R. S. Griffin, chief of the Bureau of Steam Engineering. In connection with a statement as to the Navy's oil requirement, Admiral Griffin said:

"The demand for oil for the Navy alone looks formidable in comparison with the requirements of two or three years ago, and when it is considered that a large number of merchant ships completed during the last three years also burn oil, and that many industrial establishments recently have converted their power equipment to oil burning, the question of an adequate supply of fuel oil for the Navy becomes one of great concern.

"I share the views of many regarding the national importance of conserving our oil. Without an assured supply, our Navy would be practically useless, and I shudder to think what the result would be if anything should occur that would even remotely threaten this supply.

"We now have in commission seven battleships of a combined horsepower of 204,000, which burn oil only. In addition to these, we have building twelve other battleships of 533,000 horsepower, six battle cruisers of 1,080,000 horsepower, and ten scout cruisers of 900,000 horsepower, making a total under construction of these three classes of ships aggregating 2,513,000 horsepower.

"In oil-burning destroyers, we have actually completed 234 with an aggregate horsepower of 5,626,000, and have under construction eighty-seven others which will be completed during the next fiscal year and will bring the total horsepower of destroyers up to 7,975,000.

"Our submarines already completed aggregate about 80,000 horsepower in Diesel engines, and those under construction will more than double this figure.

"Besides these vessels of a purely military character, we have others, such as mine sweepers, tugs, destroyer and submarine tenders, and fuel ships, in which oil is used as fuel, whose horsepower aggregates 173,400.

"To sum up, we actually have completed and ready for service vessels aggregating more than 6,000,000 horsepower in which oil alone is used for fuel, and have under construction other vessels which will bring this total up to nearly 9,000,000 horsepower."

The Cat Creek Field, Montana

The Frantz Corporation, headed by Frank Frantz, former Governor of Oklahoma, has brought in its second well in the Cat Creek field, in northern Montana, with an estimated production ranging from 600 to 1,000 bbl. every twenty-four hours. The grade of the oil is extremely high, running more than 50 per cent gasoline. All efforts thus far to cap the well have proved ineffective, and large dikes have been built. A third well is expected to come in soon. It is in this field that the Ohio Oil Co., a Standard Oil subsidiary, is drilling.

More Fuel for Long Beach, Cal.

The Industrial Fuel Supply Co. of Anaheim, Cal., a subsidiary of the Southern Counties Gas Co., is installing thirty miles of 8-in. pipe to convey natural gas from the Richfield district to Long Beach, Cal. This line will operate at 265-lb. pressure and will be fed through a compressor station near Placentia. Gas from this line will serve the industrial sections of Long Beach and Wilmington. H. L. Glaze, of the Arthur R. Maas Laboratories, Los Angeles, is in charge of construction.

Geological Survey Oil Policy

In connection with the departure of so many of the Geological Survey geologists to undertake oil work for private companies, George Otis Smith, Director of the U. S. Geological Survey, makes the following statement:

"The frequent news items regarding the giving of leave of absence to members of the Geological Survey to accept temporary employment of American oil companies for work outside of the United States should be taken as an evidence of the policy to stimulate this foreign exploration. From time to time Survey officials have urged American companies to supplement our rapidly disappearing domestic oil resources by acquiring some share of foreign supplies. The Geological Survey is willing to back up its faith with works. It is known that Secretary Payne has warmly endorsed this policy, even though he realizes that a bureau in his department must sacrifice somewhat its efficiency for the greater advantage to the nation."

A. F. A. Coyne, director of the Anglo-Dominion Petroleum Co., of London, England, has decided to send an exploring party of geologists into the territory northeast of Dauphin, Manitoba, where, since the discovery of a Devoman outcrop, it is believed oil will be found. The exploration will embrace an area of fifty miles east and west by sixty miles north and south.

New Oil District in Northern Kern County, Cal.

Oil men are interested in developments at Devil's Den, a new oil district in Northern Kern County, which gives promise of becoming a production district. This section is being exploited by the Standard Oil Co. and other companies. Rigs are now being constructed and materials for others are being hauled into the field. There is also considerable work being done to improve roads leading to the district. The General Petroleum Co. is drilling on Sec. 33—23—18 and is reported to be down 700 ft., with excellent indications of getting a good producer. The greatest recent feature of Kern County's oil developments was the bringing in of a big gusher by the Kern Trading & Oil Co. near Taft. The well came in with a rush of oil amounting to 1,500 bbl. per day, and the production is considered unusually good for this section of the west side fields. Much of the oil from the big well got away and flowed down the canyon in which the well is located. However, sumps were hurriedly built to care for the production without a big loss.

The Associated Oil Co., which has been drilling near McFarland since last fall, has begun construction of a second derrick at a point two miles east on Sec. 31—38—28.

Reports from the state oil supervisor indicate that there is a flurry of development work in various districts of California. Developments in the Kern River field are particularly active. Twenty-five wells are reported under test of water shut-off, twelve of which are in Kern County fields. Six other wells in Kern County are being deepened or redrilled. The Standard has abandoned three wells in the Sunset and one in the Midway district.

The Canadian Minister of the Interior was authorized last September to specify and collect royalties on sales of oil produced from crown lands. So far this power has not been exercised, as it is the policy of the government to defer the collection of royalties until oil has been found in commercial quantities and the industry placed on a paying basis, as otherwise development might be checked. Oil in small quantities is now being produced in wells driven on crown lands in Alberta.

A cablegram from the American consul at Gibraltar, under a recent date, according to Commerce Reports, states that the Gibraltar government has placed a duty of 1s. 6d. per ton of actual weight delivered on all oil for use as fuel exported from Gibraltar, whether taken as bunker or as cargo.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

What Does the Government Do With Your Money?

Amounts Spent for Mining Bureaus Compared With Those for Administration and General Purposes

In an address before the Washington Academy of Science on May 24, 1920, Dr. E. B. Rosa, chief physicist of the U. S. Bureau of Standards, presents an interesting analysis of the nation's budget for 1920.

The expenditures for the chief departments are shown in accompanying Fig. 1.

"Primary Government Functions" includes the necessary expense of maintaining the President, Congress, the various executive departments and so forth. Public Works, which is 3 per cent of the total, includes expenditures for rivers and harbors, public buildings, reclamation service, post roads, national parks, and the national railway in Alaska. The small division "R. E. & D." stands for "Research, Education, and Development Work," which consumes 1 per cent of the total. This includes the expenditures of the Agricultural Department, Geological Survey, Bureau of Mines, the Coast and Geodetic Survey, Bureau of Standards, Bureau of Fisheries, Bureau of Public Health, and the various educational bureaus.

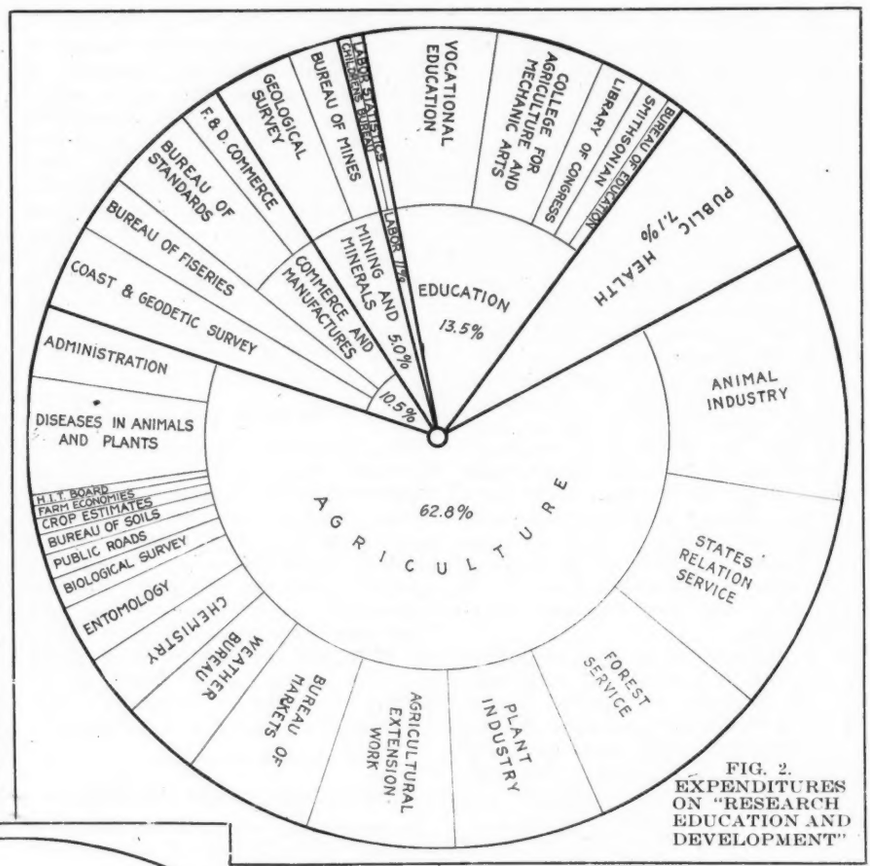


FIG. 2. EXPENDITURES ON "RESEARCH EDUCATION AND DEVELOPMENT"

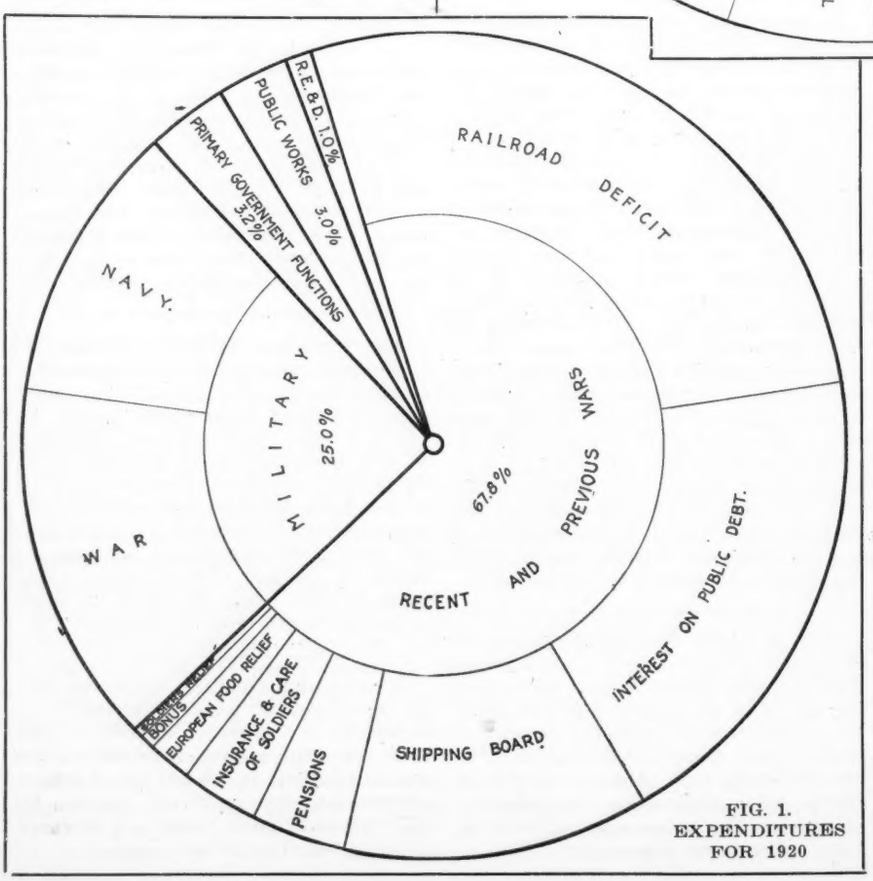


FIG. 1. EXPENDITURES FOR 1920

The detail of the expenditure of this 1 per cent is shown in Fig. 2. To the mining industry it is of particular interest to note that the Bureau of Mines and the Geological Survey receive five-one-hundredths of the total 1 per cent of the national budget. On the other hand, the Agricultural Department receives practically sixty-three-hundredths (of the total of 1 per cent) for research, education, and development.

Dr. Rosa points out that the Agricultural Department is spending about $1.50 for every $1,000 of value of agricultural and animal products; whereas the Geological Survey and the Bureau of Mines receive an annual appropriation of less than 50c. per $1,000 of the annual value of mineral products, which amounts possibly to $6,000,000,000 a year. He says, "These two bureaus are doing a work of great economic importance at a cost to the people of this country of 3c. per capita per year. If it were doubled, the burden would be only slightly increased, but the service rendered in the increased efficiency of industry and fewer accidents and a more intelligent use of our natural resources would be very considerable."

American Industry Needs Oil

Unproductive Consumption Must Be Limited and Crude Oil Developed Abroad by American Capital

Speaking before the American Iron and Steel Institute's recent meeting in New York City, the Director of the U. S. Geological Survey chose for his theme "Industry's Pressing Need for Liquid Fuels and Lubricants." In abstract, Dr. Smith's remarks were as follows:

"The last ten years might be called the petroleum decade. The world war depended on American oil wells for motive power. Gushers and oil booms increased popular faith in an inexhaustible supply of petroleum. Domestic production doubled and consumption more than doubled, so that Mexican oil has become an absolutely necessary part of our supply. These ten years mark a transition from oversupply to over-demand.

"The ever-increasing demand for gasoline and fuel oil are the outstanding oil needs, so that the question of priority in use must soon arise. With an estimate of seven billion barrels in the ground, and the 1920 consumption closely approaching a half billion barrels, which is equivalent to the flow of Niagara's flood for three hours and forty minutes, and with more than 10 per cent of our accumulated stores consumed in the last nine months, it is clear that this rapid pace cannot long be maintained. Benzol and alcohol from the coke ovens promise only enough motor fuel to meet part of the present increase in demand. Oil from oil shales will not be labor-cheap, like the petroleum now flowing from the wells. Regard for the future forces us both to plan to use less oil and to import more.

"Some restriction in gasoline consumption must soon come. Fuel oil in locomotives and stationary steam plants must give way to the demand for this fuel by the Navy and United States merchant marine, which alone this year require one-third of the output of fuel oil. Oil as a power-saver has a unique function, and the demand for lubricating oil must continue to increase as the use of machinery increases.

"Pioneering for oil in foreign countries by American capital will not only help secure the needed oil but will also furnish markets for American manufacturers, especially of steel products. Planning for the future needs to include more attention to supplies of raw materials to insure America's industrial life.

"That industry is not an end unto itself is well illustrated by a photograph, 'The Day's Work.' In the foreground a family wash hangs on the fence; beyond looms the high stack of a blast furnace; the humble home-maker and progressive Big Business. In our planning keep the American home ever in the foreground. It is this kind of vision that rouses us to protect America's supply of every essential material."

Robert W. Hunt Medal Endowment Entrusted to A. I. M. E.

The presentation of the Robert W. Hunt medal was made on the evening of May 27 at the Engineering Societies Building. The medal endowment is placed in hands of the American Institute of Mining and Metallurgical Engineers by the partners and employees of Robert W. Hunt & Co. as an appreciation by them of Captain Hunt's services and as an expression of the esteem in which they hold him. The award consists of two prizes; first, a gold medal, and second a sum of money. These awards are to be made by the A. I. M. E. not oftener than once a year, to that person, or persons, contributing to the Institute the best original paper or papers on iron and steel. The selection of the person to whom the award shall be made is in the hands of a sub-committee to be appointed annually by the Iron and Steel Committee, and is subject to the approval of the full committee.

A. A. Stevenson, acting chairman of the Medal Committee, introduced John J. Cone of Robert W. Hunt & Co., who, in presenting the endowment, spoke at some length of Captain Hunt's accomplishments in the iron and steel industry. Herbert Hoover, president of the A. I. M. E., in accepting the medal fund on behalf of the Institute, paid tribute to Captain Hunt and his many contributions to the field of engineering, and more particularly to his work in iron and steel. Charles M. Schwab, in his address, "Robert Woolson Hunt," spoke in happy vein of his early acquaintance with Captain Hunt and the continuance of that friendship which existed between them. He stated that the high position and regard which the steel industry occupies today is due in no small degree to the part played by the guest of the evening.

The announcement was then made by President Hoover that the medal committee had decided that the first Hunt medallist would be Captain Hunt himself, in view of his services. In his response, Captain Hunt expressed his appreciation of the honor bestowed upon him. Following the addresses, a reception to Captain and Mrs. Hunt was held.

The Czowski Medal, awarded by the Engineering Institute of Canada for "the best contribution to engineering literature of the year," was recently conferred on Phelps Johnson, G. H. Duggan, and George F. Porter in recognition of their 1919 publication "The Design, Manufacture, and Erection of the Superstructure of the Quebec Bridge."

"Hydraulic-Fill Dams" was the subject of discussion at the May business meeting of the American Society of Civil Engineers. Allen Hazen, the principal speaker, discussed the fundamental problems connected with the hydraulic method of dam construction.

Resources of Russia Discussed

Value of a Liaison Between the Engineers of Russia and America Emphasized by Russians

A special joint meeting of the A. S. C. E., A. I. M. E., A. S. M. E., and A. I. E. E. was held at the Engineering Society Building, New York, May 26, the subject under discussion being the value to the engineering profession of a liaison between the engineering societies of Russia and those of America, with the purpose of furthering co-operation for the benefit of the engineers of both countries.

Walter N. Polakov presided, and in introducing the speakers called attention to the trying conditions which have prevailed in Russia during the last three years and the handicaps under which engineers in that country have had to work. Such conditions, said Mr. Polakov, gave no opportunity to the engineers of Russia to apply their executive ability, but, with the gradual resumption of normal affairs, Russia would come into her own and the opportunity for productive forces would be increased. He also pointed out that resources without engineers could be but a slight asset to any country.

N. A. Stephanoff, president of the Russian Society in America, outlined the Russian engineer's scientific and practical training in comparison with that obtained by the average European engineer, and emphasized that such preparation was of a high order and compared favorably with that of engineers elsewhere. W. F. Dickson, director of the Russian Singer Co., pointed out the many accomplishments of Russian engineers and laid special emphasis on the excellence of the work done in civil, mechanical, and mining engineering. He stated that even under trying conditions the work of the Russian engineer has been pre-eminent.

Dr. J. M. Goldstein, professor of economics in Moscow University, outlined in a comprehensive manner the many and varied resources of Russia. Several comparative diagrams shown by Dr. Goldstein served to illustrate his remarks. Compared with production during the pre-war years, the potentialities of Russia as a productive nation are immense, he said, and there is required only the attention of engineers and the advancement of capital to place Russia in the high economic position that the country so justly deserves.

Mining & Metallurgical Society Postpones Medal Presentation

The Mining and Metallurgical Society of America, 120 Broadway, New York City, is conferring its medal for 1920 on E. A. Cappelen Smith. Owing to the fact that a number of the members of the society who are particularly desirous of attending the presentation find it impossible to be present at any earlier time, the ceremony has been postponed until next fall. Due notice of the date of presentation will be given later.

Book Reviews

The Mines Handbook, Vol. 14. By Walter Harvey Weed. 6 x 8½, cloth, pp. 1,992, 1920. Published by W. H. Weed, New York. Price, $15.

Shortage of paper and the printers' strike of last fall both contributed to the delay in issuing the 1920 edition of Mr. Weed's valuable book. Previous editions are familiar to most of our readers, and the new volume is much like that of 1919. A few more pages are devoted to iron producers than before, and the list of dead mining companies, which heretofore occupied about 100 valuable pages, has been rightly omitted. Such a list might be published every five years or so, for record.

An immense amount of work is necessary in publishing a book of this kind, and when it is done the work is bound to be incomplete. The information regarding companies must be obtained by an individual request, and if the company does not see fit to reply, the editor has no means of knowing whether to repeat his previous statement or to class the company among the dead ones. This is bound to result in the inclusion of some information which is out of date. In some cases, however, a little more care might have been exercised, e.g. in the tables on pages 41 and 42, which are three years old, though more up-to-date information has been published.

For the benefit of those unfamiliar with the previous volumes, the general scheme is to give, under each company treated, the address, officers, date and place of incorporation, financial statement, description of property, including geology; development, equipment, and production, with, in many cases, a brief statement as to the character of management and prospects, according to the editor's opinion. About 1,300 foreign and 5,000 United States companies seem to be covered, although we plead not guilty to having made an actual count. E. H. R.

Metal Statistics, 1920. Cloth, 4 x 6, pp. 528. Published by the *American Metal Market* and *Daily Iron and Steel Report*, New York. Price, $1.

The thirteenth edition of this book has just appeared. Like the previous volumes, it contains fairly complete statistics for all the better-known metals and metal products, including iron, for the last year and in many cases for preceding years. Production, consumption, imports, exports, stocks, grades, and uses are included. The daily metal prices given are taken from the paper issued by the publishers, and we trust we may be pardoned for thinking that they would better represent the major markets, and hence be more valuable, if secured from our columns.

E. H. R.

Report on the Iron Ore Deposits at Yampi Sound. By A. Montgomery. Paper, 5½ x 8½; pp. 32. Department of Mines, Western Australia, Perth. 1920.

Large deposits of crystalline hematite occur on Koolan and Cockatoo islands under ideal conditions from a mining standpoint. The "lodes" dip between 50 and 55 deg. from the horizontal, show some folding, and for the most part are exposed on surface. A rough estimate of available ore above the high-water mark places the tonnage at 97,300,000 for both deposits, and samples show from 41.43 to 68.99 per cent metallic iron, with phosphorus content ranging from 0.008 to 0.062 per cent. The above estimate does not take into account the extension of the lode, and no explorations have been made for the purpose of determining the depth to which marketable ore may extend, so that it may be assumed that these figures represent only a small part of the entire deposits.

Under present conditions, any attempt at a successful working of the deposits would require considerable capital, as certain difficulties must be overcome. Inaccessibility, from the standpoint of transportation, is probably the greatest of these, but with the providing of proper wharfing facilities, and the assurance that a large and continuous output would be handled, the enterprise would undoubtedly be a large and profitable one.

An important point which is mentioned by the author is the policy of the government, which requires that in so far as is possible all Australian metallic ores shall be smelted in Australia. Several cross-sections and maps are included with the report, and an earlier report by W. D. Campbell on the deposits is appended.

D. E. A. C.

Technical Papers

Mining in California During 1919—A concise review is given in Preliminary Report No. 6 issued by the State Mining Bureau, San Francisco. The work done by the various operating companies during the year is briefly outlined, general conditions are summarized, and prospects for 1920 are discussed. The review includes nonmetals. Copies of this 43-page book may be had free of charge from the publishers.

Sierra County, California—The California State Mining Bureau, San Francisco, has published "Mines and Mineral Resources of Sierra County," a 144-page pamphlet for which no charge is made. Detailed descriptions of all mining properties are given. The county is famous for placer mining and has large deposits of auriferous gravel. Gold production in 1918 amounted to $289,368.

Chromite—"Chromite in 1918," a sixty-eight-page pamphlet which will later be incorporated in *Mineral Resources*, may be had free of charge on application to the U. S. Geological Survey. It describes the various American and principal foreign occurrences, with assays and production figures. The compilation shows that 92,322 tons of chromite (about 40 per cent Cr_2O_3) was mined and shipped in the United States in 1918. This was by far the largest domestic production yet made, and equal to about one-third of the world's total production.

Directory Montana Mines.—The Montana State School of Mines, Butte, Mont., has published a directory of the metal and coal mines in the state. The pamphlet gives the location, officers, operators, power required, number of men employed, character of ores and 1918 production of 95 metal-mining and 31 coal-mining companies. It may be obtained free on request.

Copper—"Copper in 1917," a pamphlet of seventy-three pages, which will form a part of *Mineral Resources*, has just been issued and is obtainable free from the U. S. Geological Survey, Washington. Production data in the various districts of the country are given, together with price statistics and short notes on the various mines and reduction works.

Nevada County, California—"Mines and Mineral Resources of Nevada County" has just been published, and may be had free of charge from the State Mining Bureau, San Francisco, Cal. Detailed descriptions of the various properties cover 270 pages. Gold quartz is the principal mineral mined. Some hydraulic mining is still being done, but this branch of the industry has been suppressed to a large extent by legislative enactment. The county produced gold to the value of $3,070,453 in 1918.

Payson District, Arizona—*The Arizona Mining Journal*, Phoenix, Ariz. (price, 20c.) has an interesting article in the May issue by the editor, Charles F. Willis, on the possibilities of this region. Many gold claims have been located, and the old type of prospector is much in evidence. Transportation difficulties have interfered with serious development, as Payson is in that comparatively unknown part of the state just south of the Mogollon mesa, 100 miles from Globe and 102 miles from Phoenix. Long miles they are, too.

Mineral Resources of the United States, 1917: Part II, Non-Metals. U. S. Geological Survey, cloth, 6 x 9; pp. 1,293. Obtainable free from the U. S. Geological Survey, Washington, D. C. This volume is a combination of many separates. It is particularly important as a record of production under the influence of the war.

"Lead in 1917"—Publication of this U. S. Geological Survey paper has been greatly delayed, and its only value now is as a reference for statistical information.

MEN YOU SHOULD KNOW ABOUT

E. B. Jennings will be in charge of a placer mine near Craig, Col., during the coming summer.

M. F. Crossett, of Denver, Col., is making an examination of the fluorspar properties of southwestern New Mexico.

Walter L. Maxson, research engineer of New Jersey Zinc Co., Palmerton, Pa., was in New York during the last week.

E. M. Marshall has been examining the Lordsburg, N. M., district for copper possibilities for San Francisco interests.

H. Robinson Plate, mining engineer, Hobart Building, San Francisco, is in New York City. He expects to return to San Francisco within two weeks.

Clifford Raitor is on his way to Chuquicamata, Chile, where he will be on the staff of the Chile Copper Co. Mr. Raitor was at one time employed in Hibbing, Minn.

T. H. Jenks, mining engineer, 1221 Royal Court, Los Angeles, Cal., has left New York City for Denver, Col. He will spend the summer in professional work in Hinsdale County and other districts of Colorado.

M. G. Baker, vice-president of Vanadium Corporation of America, who has been visiting the company's property at Minasragra, Peru, sailed on June 4 for New York, where he expects to arrive June 16.

Edward F. Merril has been appointed general manager of the Dominion Iron & Steel Co. and the Dominion Coal Co. He will reside in Sydney, N. S., and have charge of the operations of the two companies and their subsidiaries.

Harry S. Denny, C. B. E., mining engineer of London, England, prominently identified with the mining industries of Australia, South Africa, and Mexico, is examining mining properties in Quebec province, in the interests of British capitalists.

Mining Men and Engineers Recently Visiting New York City included: H. H. Hoppoch, of Joplin, Mo.; C. Vey Holman, of Rockland, Me.; Seeley W. Mudd, of Los Angeles, Cal.; S. C. Rudra, of Calcutta, India, and Arthur E. Hepburn, formerly of Vancouver, B. C.

Capt. D. Vogt, president of Kristiansands Nickel Refining Co., Norway, and a member of British-America Nickel Corporation of Toronto, Ont., arrived in New York on May 25. Captain Vogt proceeded to Ottawa, where he is inspecting the new refinery of the corporation.

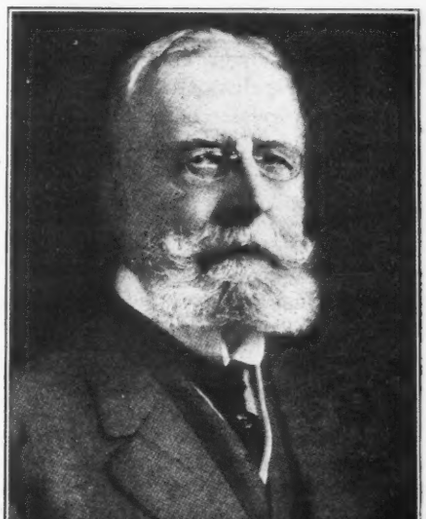
Edwin T. Hodge, mining engineer, president of the British Columbia Chamber of Mines, and on the executive board of the Vancouver branch, Canadian Mining Institute, has accepted the position of professor of economic geology at University of Oregon.

A. E. Drucker, professor in the Wisconsin State School of Mines, Platteville, Wis., with a party of students, recently visited the mines and milling plant of the Wisconsin Zinc Co. at New Diggings and Shullsburg. The party also visited the new acid works of Vinegar Hill Zinc Co., at Cuba City.

Louis Arnold, formerly with the engineering department of Oliver Iron Mining Co., Hibbing, Minn., is on his way to South America, having accepted a position with the Braden Copper Co., whose properties lie about 160 miles east of Valparaiso. Mr. Arnold is a graduate of the University of Minnesota School of Mines.

Dorsey A. Lyon, superintendent of western station; **R. T. Stull**, chief ceramist, and **Leon I. Shaw**, assistant chief chemist, U. S. Bureau of Mines, were recently in Seattle to confer with local officials. **H. C. Parmelee**, editor, and **L. W. Chapman**, western editor, of *Chemical and Metallurgical Engineering*, accompanied the party.

OBITUARY



EDMUND GYBBON SPILSBURY

Edmund Gybbon Spilsbury, consulting mining and metallurgical engineer, died of heart disease on May 28, at the New York Eye and Ear Infirmary, where an operation for cataract had been performed successfully a few days previously.

He was president of the American Institute of Mining and Metallurgical Engineers in 1896, and of the Engineers' Club of New York City in 1916 and 1917. He was also a member of the American Society of Mechanical Engineers, the Institution of Mining and Metallurgy of Great Britain, the Mining and Metallurgical Society of America, the American Electrochemical Society, and the Rocky Mountain Club of New York. As a representative of one or another of the national engineering societies he was a trustee of the United Engineering Society from 1916 until his death; a member of the Engineering Societies' Library Board from the time of its organization in 1913 until this year, having been its chairman from 1918 until last January; and a member of the Engineering Foundation from 1916 until his death. He was also a member of the Division of Engineering of the National Research Council of Washington and New York.

Mr. Spilsbury was born in London, England, in 1845, and obtained his preliminary education in Liège, Belgium. His technical education was gained at the University of Louvain, from which he was graduated in 1862. He then took a course at Clausthal, Germany. After working in various parts of Europe, for several firms, Mr. Spilsbury came to the United States in 1870, to investigate this country's resources in lead and zinc for an Austro-Belgian firm. Following two years in this work he resigned to enter buisiness here. He was the first engineer to introduce the Harz system in ore mines of Pennsylvania and New Jersey.

Mr. Spilsbury's practice as a consulting and mining engineer took him into many parts of Europe, Africa, the United States, Mexico and South America. During the winter and early spring of this year he spent a number of weeks in Brazil on a mining propect for clients in this country, and had returned to this city only a few weeks prior to his death.

He was managing director of the Trenton Iron Co., Trenton, N. J., from 1888 to 1897. While manager of these works he introduced as specialties of their business the Elliott locked wire rope and the Bleichert system of aërial tramways.

Mr. Spilsbury is survived by a daughter and three sons, one of whom, Percifor G., is also a mining engineer.

George Goldwin Smith Lindsey, K. C., of Toronto, died on May 27, after a short illness, at the age of sixty years. Mr. Lindsey, a native of Toronto, was a lawyer by profession, but devoted himself largely to mining affairs, particularly to mining law. He was for many years president and managing director of the Crow's Nest Pass Coal Co. and in 1914 was elected president of the Canadian Mining Institute. He was also president of the Western Development Co., of the North Alberta Coal Co., and of the Vancouver Portland Cement Co. In 1915 he went to China on behalf of British mining interests and during his sojourn was engaged by the Chinese government to compile its mining laws.

John A. Knapp, mining engineer and metallurgist, secretary of the Chicago & Aurora Smelting & Refining Co., and a graduate of College of City of New York, as well as of the School of Mines, Columbia University, died on May 22, at his home, 11 Echo Ave., New Rochelle, N. Y. Mr. Knapp was seventy-two years old.

THE MINING NEWS

LEADING EVENTS

Restrictions on Quapaw Lands Expire Next Year

Oklahoma Operators Preparing To Resist Possible Efforts To Retain Them

Mining men of the Picher district of Oklahoma are planning to resist any measure introduced in Congress that would tend to retain the restrictions on the Quapaw Indian lands in Ottawa County, Okla. The lands of the Quapaws comprise the northern half of the county, and include most of the mineralized area where the camps of Picher, Tar River, Douthat, St. Louis, Hockerville and Quapaw are located. All mining is being conducted on these lands now by authority of leases that must be approved by the Government. The original grant to the Quapaws, however, has been decided by the courts as a fee simple, loaded with a reservation prohibiting the sale of the lands by the Quapaws for 25 years. As this grant was signed by President Grover Cleveland in 1896, it will expire in 1921, and unless a new law is passed by Congress continuing the restrictions, they will be a thing of the past.

The growth of the towns, and particularly the handling of school affairs, has been a very difficult matter on account of the Indian ownership of the lands. School taxes in the Picher school district are 8c. on the dollar as compared with a few mills tax in districts where there is no Indian land.

Vanadium Corporation's Railroad Near Completion

The narrow-gage railroad that is being built by the Vanadium Corporation of America over the 13-kilometer stretch between its mines at Minasragra, Peru, and a point overlooking Jumasha on Lake Pun Run will be completed by July 15, it has been announced by J. Leonard Replogle, president of the company. The Foundation Company is doing the work under contract. A large tonnage of ore is at the mine awaiting completion of the road for shipment.

The number of directors on the Vanadium board has been increased from twelve to fifteen. The new members are E. E. Fernandini, of Lima, Peru; Col. M. G. Baker, vice president of the company; and L. K. Diffenderfer, secretary. An executive committee has been appointed consisting of J. Leonard Replogle, chairman, Charles M. Schwab, E. R. Tinker, Joseph De Wyckoff and F. K. Sheesley. Col. Baker is expected to arrive in New York on June 16 from Peru, where he has been visiting the company's property.

WEEKLY RÉSUMÉ

The labor situation is quiet, men being reported scarce in many districts. Wages have been raised to the Sudbury scale at Porcupine by the Hollinger and Dome companies. An attempt to reopen the Minerals Separation case has been made by Miami Copper, which alleges discovery of new evidence. In Oklahoma, it is announced, mining men will oppose any efforts to retain the restrictions upon Quapaw Indian lands, which expire next year. At Butte, the Montana Power Co. has completed a wireless station. The new Canadian steel merger has received a Nova Scotia charter.

At Washington, the House Committee on Mines and Mining has voted down the Raker proposal to suspend assessment requirements in 1920. The bill for liberalizing war-minerals relief legislation introduced in the Senate in April was passed June 2, but the House measure is still held up. A loan to silver producers has been proposed by Senator Henderson. Federal operation of Government nitrate plants has been approved by the Senate committee.

Montana Power Co. Completes Wireless Station

The big wireless station of the Montana Power Co., located on the famous Butte hill, overlooking the mines, at an altitude of 6,500 ft., has been completed and is ready for business, according to an announcement from the general superintendent, M. E. Buck. "Pickup" messages have been received from Washington, D. C., and communication maintained with Cape Blanco, 800 miles distant. The Butte station is one of three constructed to establish ready communication between the power plants of the company in Montana, and with a view to establishing a wireless telephone system later.

Ontario Laborites Would Amend Compensation Act

Amendments to the Workmen's Compensation Act of Ontario are up in the Ontario legislature, and are being fostered by the labor members. The present basis of compensation is 55 per cent of the wages if men are incapacitated through accidents for a period longer than seven days. The labor members are asking that this be raised to 75 per cent. It is pointed out, however, that this would be a big inducement to lay off as long as possible after an accident. From figures presented in the House it was shown that, if in the northern mining districts a laborer was laid up through an accident for ten days, the amount of wages involved would be $45, but that the actual cost for doctor, hospital, ambulance, together with the amount paid in compensation, would be $140.

Miami Copper Seeks To Reopen Minerals Separation Suit

Alleges Discovery of Important Evidence in Treatise by Sulman and Picard Hitherto Unpublished

On May 26 in the United States Circuit Court of Appeals for the Third Circuit, in Philadelphia, an interesting and possibly very important appeal was made by the Miami Copper Co., in a petition to file a supplemental bill which, if granted by the court, would reopen the Minerals Separation-Miami Copper Co. infringement suit, so as to admit some new evidence which has recently, and somewhat accidentally, come to light.

In the arguments, which consumed about four hours, counsel for the Miami company set forth what they considered to be the "importance," "materiality" and "competency" of the newly discovered evidence, while, on the other hand, counsel for the Minerals Separation, Ltd., contended that everything contained in this so-called new evidence had actually been before the court when the decision, upon which accounting proceedings have for some time past been carried on, was rendered by the court.

It seems that in checking up certain testimony given by one of the Minerals Separation's witnesses, as to an elevator, referred to in an article by Theodore J. Hoover, published in *Engineering and Mining Journal* on April 30, 1910, counsel for the Miami company had an interview with Mr. Hoover as to the interpretation placed upon the use of the elevator as an agitating device of the process of "the first patent in suit" (No. 835,120). As a result of this interview Mr. Hoover divulged the fact that he had in his possession a typewritten manuscript of a treatise by Sulman and Picard, entitled "The Theory of Concentration Processes Involving Surface-Tension." It was stated that, at Mr. Ballot's suggestion, Mr. Hoover had obtained this treatise from Sulman and Picard in order that he might be instructed as to the process, Mr. Hoover at that time being superintendent or manager for Minerals Separation, Ltd.

This manuscript is interesting, in that the authors, who are two of the inventors of the principal patent of Minerals Separation, make a distinct classification of all different flotation processes, by which and by the discussion whereof it is shown that at the time of the writing of this treatise, which was some time shortly after the development of the Sulman, Picard, Ballot and Higgins process, these two joint inventors recognized that Froment was the first to use gas bubbles exclusively as the lifting

force to raise slightly oiled mineral particles to the surface as a froth, in contradistinction to the "oil buoyancy" processes, such as the earlier Elmore (1898-1901) process, where the lifting force was mainly the buoyancy of oil. Sulman and Picard classify the Elmore vacuum process (1904) as a gas or air buoyancy process, and it would seem, from the arguments of Miami counsel, that these inventors of the Minerals Separation process distinctly state in this treatise that what they added to the art was simply a new manner of introducing the gas (air). Froment introduced gas by chemical reaction (that of acid upon carbonates added to, or present in the ore), whereas in the Minerals Separation process, the gas (air) is introduced by mechanically agitating the pulp in such a way as to "whip in" air into the pulp; in all other respects the two processes are the same, each using a minute quantity of oil, each utilizing air exclusively as the lifting force, and each producing the same result, namely, a coherent froth.

In arguments for Minerals Separation, it was contended that such views as were expressed in the treatise were mere scientific theorizing of Mr. Sulman—views which he had subsequently abandoned, as shown by his testimony taken in London in the Hyde case—and that it was immaterial and even had it been before the court, it would have in no way affected the decisions.

Counsel for Minerals Separation contended, also, that the Supreme Court had defined this process as one having under 1 per cent of "oil," when as it had been shown by experiment that Froment must have used very much more than 1 per cent, and that the word "minute," as used in the treatise, was not the same as the term "minute" would mean in referring to the Minerals Separation process.

Answering this, Miami counsel quoted from the treatise, to the effect that in both the Froment and the Minerals Separation processes, the "oil" used was in such minute quantities that the film coating on the mineral "to all intents and purposes becomes part and parcel of the particle."

Counsel for Miami Copper Co. had the closing arguments, in which they pointed out that in the treatise, Sulman and Picard had distinctly stated facts, not theories, from which it appeared that the principle of operation of the Froment process and of the Minerals Separation process was the same, producing the same result, and that the Minerals Separation process was considered by these two co-inventors and by Mr. Ballot, who had recommended that Mr. Hoover inform himself from this treatise, to be agitation of the pulp so as to "whip in" air by mechanical means.

The importance of all this undoubtedly is the limitations which this would place upon the character of agitation which may be considered to be the agitation of the process, and as to whether Minerals Separation is at all justified in its present attempt to construe such agitation as is incidental to the ordinary passage of oiled pulp through a mill, or the agitation due to bubbles entering a porous bottom cell, to be the agitation of the Minerals Separation process. The scope of the claims as to what is the agitation of the process has not, as yet, been passed upon by the Supreme Court, nor was the scope of the claims as to degree of agitation definitely passed upon by the Circuit Court of Appeals in the Miami case.

Hollinger and Dome Raise Wages To Meet Sudbury Scale

The Hollinger and Dome mines, in the Porcupine district of Ontario, have announced a raise in wages to meet the new scale lately established in the Sudbury district. Loaders and machine helpers will be paid $4.75 and machinemen $5.25 for an eight-hour shift. In the Cobalt district the operators have decided to continue the present bonus of $1.25 a shift, despite the reduction in the price of silver. This means $5.25 for machine-men, $4.75 for machine helpers and $4.25 to $4.50 for trammers and muckers.

Six Per Cent Tax on Metal Mining Proposed in Montana

A petition to initiate a bill providing for a state license tax of 6 per cent on the net proceeds of mines was recently filed at Helena, Mont., in the office of the Secretary of State. W. B. Sands, of Chinook, Mont., was the author of the arguments accompanying the bill. The measure provides for a tax of 6 per cent on all metal mining in Montana and a penalty of 50 per cent for failure to make a true report. A bill providing for a new method of collecting taxes on all property is also proposed in a second petition.

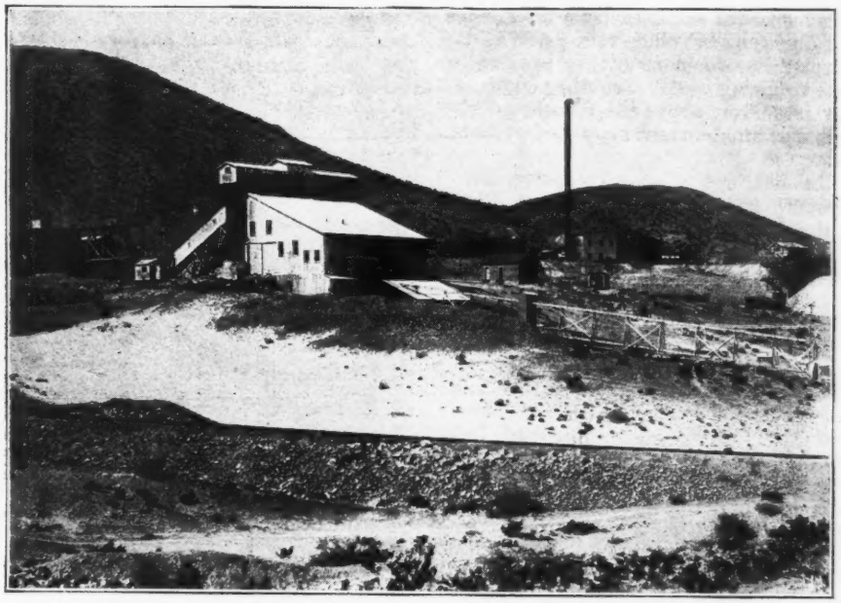
Calumet & Arizona Announces Purchase of 85 Mine

Sale Reported To Be Contingent on Investigation of Title—Concentrator Will Be Shut Down

It has just been announced that the Calumet & Arizona Mining Co., of Bisbee, Ariz., has purchased the Eighty-five mine at Lordsburg, N. M. An account of this deal was published in *Engineering & Mining Journal* of May 15, with further details in the following issue. It is stated that the purchase is contingent upon an investigation of title. The ore is highly silicious which makes it particularly desirable at the present time at the Calumet & Arizona smelter at Douglas, where silica is at a premium.

Formal transfer of the property was made June 1 by the Calumet & Arizona company, possession being taken as of May 1. The sum of $350,000 was paid. It is rumored, though unconfirmed, that the purchase price was $1,030,000. Development work is to be started to block out new ore reserves. The main shaft will be sunk 350 ft. deeper, giving a total development on the vein of 1,100 ft. from the zero level or 1,350 ft. from the apex. The mill will be shut down, as all ore will be shipped to the C. & A. smelter at Douglas. Karl I. Mohler is in charge of all operations.

The deal has stimulated activity at adjoining properties. The Malone-Killebrew group of five claims adjoining the Eighty-five ground on the west has been sold and the Battleship group of three patented claims, that is surrounded on three sides by Eighty-five ground on the east end of that property, has been taken under lease by B. M. Peterson for three years. A steam hoist has been installed and the lower shaft unwatered.



SURFACE PLANT AT EIGHTY-FIVE MINE, IN LORDSBURG DISTRICT, NEW MEXICO, RECENTLY PURCHASED BY CALUMET & ARIZONA MINING CO. FLOTATION PLANT, ORE BINS AND POWER HOUSE ARE SHOWN

Andes Copper Mining Co. Erecting Modern Town on Chilean Desert

Potrerillos, Where Mill Is Planned, About Ten Thousand Feet Above Sea Level

The Andes Copper Mining Co. is erecting a modern townsite at Potrerillos, Chile, a view of which is shown in the illustration used on the front cover of this issue. The elevation of the plateau on which Potrerillos is situated is about 10,000 ft., above which rise the surrounding peaks, some to a height of about 18,000 ft. The town is on the edge of a canyon which cuts the plateau in a gash 3,000 ft. deep.

Houses, modern in every respect, and as attractive as many to be found in the suburbs of New York, are being erected for the employees of the company with the idea of keeping the men perfectly satisfied so far removed from home. In this the company has been successful. A water line for domestic use was completed during 1919, together with a large reservoir above the townsite. This furnishes an abundant supply of potable water.

The holdings of the company comprise 270,994 acres of land, according to the last annual report of the Anaconda Copper Mining Co., 1,250 of which were acquired in 1919, during which year title to all mining claims, millsites, rights of way, water rights and other property was perfected.

The company completed the sixty-mile Potrerillos railway last year and the first train arrived at the millsite, near the town, the first day of last month. The 2½-mile interconnecting link was also completed between the main line and the mine railway. This is divided into two sections, one from the millsite to the mouth of the main adit, the other from the main adit to the mine. The first section is practically completed, including three tunnels aggregating 6,364 ft. in length.

Churn drilling to the extent of 12,546 ft. was done during the year, a portion of which was confined to an area south of the territory formerly drilled and by which approximately 33,000,000 tons of ore of average grade was added to the reserves. There still remains a large and promising area to be drilled. The total tonnage developed to Dec. 31, 1919, amounted to 120,000,000 tons of ore having an average copper value of 1.48 per cent.

Work on the "La Ola," or main water supply, was confined to completing the surveys, road building for handling material and tunnel work. Of the six tunnels on this line, aggregating 7,921 ft. in length, 5,571 ft. have been driven, 3,068 ft. of which were driven during 1919.

The main adit was driven 4,270 ft. during the year, making a total of 8,000 ft. in length. Shaft sinking, which was started in order to facilitate the driving of the tunnel, was abandoned, owing to the fact that a larger volume of water than could be handled was encountered in the shaft. In November, a heavy flow of water amounting to 3,000 gal. of water per minute was struck in the main adit.

All of the general drawings for the reduction works were practically completed, and a pilot plant, located at the mines, was put into operation, in which working unit tests are being conducted demonstrating the process which has been evolved. The millsite may be seen in the illustration referred to.

Santiago Mining Co. Preparing To Use Caving System

Development work at the Santiago Mining Co.'s Lo Aguirre mine in 1919 was confined chiefly to preparing for mining by the caving system, according to the annual report of the Anaconda company, the parent company. Haulage drifts, raises and other development work to the extent of 8,264 ft. were driven during 1919. A new body of sulphide ore was cut in the central section on the haulage level, which, when developed, will add a substantial tonnage of approximately 3 per cent copper to the ore reserves. Lo Aguirre is about 12 miles west of Santiago, Chile.

The main shaft of the Africana mine, 3 miles east of Lo Aguirre, was sunk 330 ft. during 1919, making a total depth of 588 ft. The total advance in all workings was 3,672 ft. Shaft No. 2, 2,000 ft. from shaft No. 1, was sunk to a depth of 233 ft.; a level connecting the bottom of this shaft with shaft No. 1 was opened, and a head frame, pumps, compressor and air drills installed.

At both Lo Aguirre and Africana properties townsites were established and dwellings built to house the present employees in a most satisfactory manner.

A decision giving the Federal Mining & Smelting Co. of the Coeur d'Alene district of Idaho, title to $500,000 worth of ore alleged to have been extracted from beneath certain holdings of the Star Mining Company, was reversed by the United States Circuit Court of Appeals in San Francisco on May 17.

Western Zinc Oxide Company Announces Officers

The Leadville Zinc Co. of Leadville, Col., which is controlled by Jesse F. McDonald, of Leadville, and Charles J. Walker and others, of St. Louis, who are the chief factors in the Down Town Mines Co., was recently merged with the Western Zinc Concentrating Co., also of Leadville, to form a new company known as the Western Zinc Oxide Co. An account of this merger is given on page 1039 of the May 1 issue of *Engineering and Mining Journal*, in which, however, the Down Town Mines Co. is referred to without mention of the Leadville Zinc Co., the latter being new to the Leadville district under this name.

Officers of the Western Zinc Oxide Co., as announced by that company, are Charles H. Collins, president and manager; C. J. Walker, vice-president; J. B. McDonald, treasurer; H. L. Noble, secretary. The directors are Charles H. Collins, C. J. Walker, J. B. McDonald, E. C. Granbery, and Jesse F. McDonald. The last named has been manager of the Down Town company.

Schedin Studio, Leadville, Col.

PENROSE SHAFT, DOWNTOWN MINES CO., LEADVILLE, COL.

Gertie Company's Application Denied at Wallace, Idaho

The application of the Gertie Mining Co. for an order permitting it to examine, survey and sample the workings of the Hecla Mining Co. east of the shaft, upon allegation that the latter company had trespassed upon and removed much ore from the Gertie ground, has been denied by the district court in Wallace, Idaho.

The Hecla company admitted having crossed the corner of the Gertie claim on the 1,600 level and the court issued an order permitting the Gertie to examine that particular section only, holding that the showing made was not sufficient to warrant a general survey of the Hecla workings. The management of the Hecla had offered to allow an examination to that extent before the matter had been taken into the court.

West End Chemical Co.'s Potash Plant Near Completion

Construction Undertaken During War —Company Has Lease from Government on 2,200 Acres

Final construction of the West End Chemical Co.'s plant at Searles Lake, Cal., is now actively under way. For the last two years construction work has been going on preparatory to the commercial production of potash and borax. The necessary machinery is being installed so that commercial potash will probably be ready for the market in the fall. After that, equipment for the manufacture of borax will be installed.

The plant is on property owned in fee simple by the company on the shores of Searles Lake. The company has the right to pump the brine from an area of about 2,200 acres, under lease from the U. S. Government for an indefinite period. The property has already been developed to the extent of sinking necessary wells and installing pumping equipment. A 12-in. pipe line over five miles long has been laid from the pumps to the plant and a roadway, power lines and narrow-gage railroad constructed for the same distance. Immediately surrounding the plant are the boarding house, machine shops, warehouses, ice plant, office building, and cottages for employees, as well as a rock quarry, gravel pit, railroad siding and station.

The company has also built and equipped an experimental plant, in which a process for extracting chemicals contained in the brine has been worked out. The camp is electrically lighted and equipped with telephone service between the buildings and the outside main line. There is a complete salt-water system for fire protection, with hydrants and piping running to and around the buildings; also a complete fresh water system, piped to all buildings. Cheap German potash will probably be a competitor of that produced at Searles Lake.

New Canadian Steel Corporation Gets Nova Scotia Charter

The British Empire Steel Corporation, capitalized at $500,000,000, in which the Dominion Steel Corporation, the Nova Scotia Steel & Coal Co. and a number of manufacturing, shipbuilding and transportation companies are merged, has secured a charter of incorporation from the province of Novia Scotia. An application for a charter was made in the first instance to the Dominion government, to which some objections were raised in Parliament, the government promising that a thorough investigation would be made before a charter was granted. Thereupon proceedings in that quarter were discontinued, and a provincial charter obtained.

Some doubts are expressed as to the validity of a provincial incorporation in the case of a company doing business throughout Canada, the point being one on which legal authorities are conflicting, and it is considered not unlikely that some legal entanglements may result before the question is definitely settled.

Utah Copper Sues To Test Ruling of Industrial Commission

Legality of Act Creating State Board To Be Questioned—Decision in Rushton Case Protested

The Utah Industrial Commission is to be the defendant in a suit brought by the Utah Copper Co. to test a ruling by the commission in an individual case, and also to draw into question the legality of the act creating the commission. The case in point is that of Louis J. Rushton, deceased, who was killed Jan. 2, 1919, by an unexpected blast of powder, while clearing out the banks of Salt Lake and Utah canal, and blasting ice which had collected. The widow was awarded compensation for the accident for herself and several minor children as well as for a posthumous child. Objection is made by the Utah Copper Co. on the ground that provision cannot be made for a posthumous child, and that as Rushton was an emergency employee, and therefore to be classed as a casual worker, not regularly on the books of the company, responsibility for his death could not be claimed. The question as to the nature of the employment will come up, as to whether Rushton in repairing an irrigation canal was engaged in agricultural work, which would have a bearing on the nature and amount of the indemnity. Finally, as already stated, the legality of the act itself, which created the industrial commission, is to be questioned.

Schedin Studio, Leadville, Col.

PLANT OF WESTERN ZINC CONCENTRATING CO., LEADVILLE, COL.

Judgment in Sixteen-to-One Mining Co. Case Upheld

The judgment of $61,000 awarded the Sixteen-to-One Mining Co. of Alleghany, Sierra County, Cal., against the Twenty-One Mining Co. of the same place, has been upheld by the United States Circuit Court of Appeals. The Twenty-One company was denied a rehearing.

The judgment followed two trials in the United States District Court. In the first, the Sixteen-to-One company was given damages in the sum of $100,000, less the cost of extraction. In the second there was a stipulation that the ore was worth $21,000 and that the cost of mining and milling was $61,000. The award was, therefore, $61,000, and it was against that verdict that the appeal was taken.

Tonopah-Divide Change Rumored

There is an unconfirmed rumor in circulation at present in Tonopah that the management of the Tonopah Divide Mining Co. is about to change. It is said that E. A. Julian, the present general manager, and Mr. Star, the present mine superintendent, are to retire, and that William Watters, who was in active charge when ore was struck, is to resume as superintendent.

MEMBERS OF WASHINGTON STAFF OF U. S. BUREAU OF MINES AND OF WAR MINERALS

1, P. S. Black; 2, C. L. Colburn; 3, K. Baumgarten; 4, Philip N. Moore; 5, C. B. Holmes; 6, J. F. Shafroth; 7, W. R. Crane; 8, R. B. Moore; 16, C. E. Munroe; 17, H. C. Meyer; 18, Van. H. Manning; 19, F. J. Bailey; 20, F. G. Cottrell; 21, G. S. Rice;

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

McFadden Bill for Gold Premium Favored by House Committee

Jewelers Protest, Claiming Tax Should Be Borne by Entire People and Not by Manufacturers Alone

Indications are that the Ways and Means Committee of the House will report favorably the McFadden bill which provides for the payment of a premium of $10 an ounce to producers of newly mined gold. The bill has been the subject of two hearings before the committee. At one, the proponents of the measure appeared. At the other the opposition was heard. The principal witnesses in behalf of the bill were Representative McFadden, of Pennsylvania, and H. N. Laurie, of the American Mining Congress.

It was pointed out by those favoring the bill that, regardless of the ethics of the situation, the production of gold has fallen to such a point that it is necessary to stimulate its mining. Unless action is taken promptly, the committee was told, the slump in production will continue in an increasing ratio.

The opposition is headed by Representative Lehlbach, of New Jersey. He introduced a number of manufacturing jewelers, who also testified. They referred to the traditional position of the Treasury Department against a bonus on gold production and referred to recent pronouncements in the same tenor by the Federal Reserve Board. They argued that if any bonus should be paid, it should be borne by all the people rather than by the arts and trades using gold. They also entered vigorous protest because they were not notified that the McFadden measure was to be taken up by the committee and that they had been given no time to assemble data and to prepare a case.

House Against Further Suspension of Assessment Work

The effort on the part of Representative Raker, of California, to have the requirements for annual assessment work on mining claims suspended for still another year met a decisive defeat in the House Committee on Mines and Mining on May 27. After listening to arguments in favor of the proposition from Representative Raker, and to the reasons advanced by Representative Taylor, of Colorado, and Delegate Grigsby, of Alaska, the committee voted down the Raker proposal by a vote of seven to three.

The principal arguments offered against the measure were that it retards the development of the industry and is particularly in the interest of holders of large numbers of claims. Among the arguments advanced by Representative Raker were the difficulties of securing labor and the demoralization of agriculture and road-building enterprises by further depleting their already scant labor supply.

It is believed that the committee reflects the sentiment in Congress against any further suspension of assessment work requirements, and it is probable that no further serious efforts will be made looking to relief from that provision of existing law.

Senate Passes War Minerals Relief Bill

Differs Slightly From House Measure, Which Is Still Held Up by Committee on Rules

A bill amending the War Minerals Relief Act was passed by the Senate on June 1. This is the bill that was introduced in the Senate in the latter part of April when friends of the measure were fearful lest action might not be secured in the House. The bill as passed is practically the same as that agreed upon by the House Committee on Mines and Mining except for the paragraph conferring jurisdiction to the Court of Claims. The purpose of the bill, Senator Poindexter points out in his report, is to put war minerals claimants on the same footing with claimants seeking relief for losses growing out of contracts.

At this writing, the House Committee on Rules has given no indication as to the action that it may take on the War Minerals Relief bill. There is a feeling that the Committee on Mines and Mining has been treated with scant courtesy in the matter, but there is thought to be a chance that the committee will allow the bill to come up for discussion in the House.

Two awards were made by the War Minerals Relief Commission during the week ended May 8. In the claim of the Nisi Prius Leasing Co. 67 per cent of the amount claimed, or $6,300.37, was allowed. The mineral involved was manganese. An award of $2,230.65 was made in the case of the Minerva Tungsten Corporation. This amount was in

RELIEF COMMISSION ON STEPS ON NEW INTERIOR BUILDING, WASHINGTON, D. C.

Matthew Van Siclen; 9, Oliver Bowles; 10, A. Stewart; 11, Mr. Cochrane; 12, T. T. Read; 13, O. P. Hood; 14, M. F. Leopold; 15, 22, J. O. Lewis; 23, Mr. Davis; 24, Mr. Sanford; 25, J. W. Thompson; 26, G. S. Pope; 27, W. W. Adams.

the nature of a reallowance, $48,293.92 having been awarded previously. The total amount claimed was $72,643.43.

Awards recommended by the War Minerals Relief Commission during the week ended May 22 are as follows (the name of the claimant, the mineral, the amount recommended, and its percentage relationship to the amount of the original claim are shown): The Virginia Ores Corporation, manganese, $20,039.68, 20 per cent; Black Bess Chrome Co., chrome, $1,591.12, 45 per cent; J. H. Schott, tungsten, $388.23, 30 per cent; E. C. Trask, chrome, $483.99, 12 per cent; Golconda Mining Co., chrome, $1,143, 14 per cent; Kester & Priest, chrome, $373.75, 49 per cent; John B. Fonder, manganese, $1,373.75, 56 per cent.

Senate Committee Favor Federal Operation of Nitrate Plants

By unanimous vote the Senate Agriculture Committee on May 31 ordered a favorable report on the Wadsworth bill, authorizing the acquisition and operation by the War Department of the nitrate fixation plants at Sheffield and Muscle Shoals, Alabama, through a corporation to be organized under the direction of the Secretary of War.

The Government would be empowered by the bill to "purchase, acquire, operate and develop" the Sheffield and Muscle Shoals plants and also all real estate and machinery located there, as well as the fixed nitrogen research laboratory at Washington, the Waco limestone quarry in Alabama and the electric power unit at the Warrior River station of the Alabama Power Company.

The corporation under which the plants would be operated would be known as the United States Fixed Nitrogen Corporation and would have a board of directors of not fewer than three nor more than eleven members, to be appointed by the Secretary of War. It would have authority to sell to the United States any nitrogen products it might manufacture for military or other purposes and to sell surplus products to producers or users of fertilizers.

The committee also adopted an amendment proposed by Senator Ellison D. Smith, of South Carolina, authorizing the War Department to sell one-half of the 300,000 tons of nitrate which it has in storage.

Proposes Loan to Silver Producers

The Secretary of the Treasury would be authorized under a bill introduced on May 31 by Senator Henderson, of Nevada, to make loans to silver producers so that they can continue operations and not be compelled to throw silver on the market, in view of lower market prices for that metal. Loans of 87½ cents on each ounce of silver would be permitted at 4¾ per cent interest. The measure was referred to the Finance Committee.

Chemists Object to Patent Bill

Objections have been raised by industrial chemists to the bill authorizing the Federal Trade Commission to administer inventions and patents of employees in the Government service. It is feared that the bill, as it now stands, would give undue advantage to Government employees and would discourage initiative on the part of outside inventors. As Representative Nolan, the chairman of the House Committee on Patents, regarded the objections as being somewhat justified, the bill has been referred to a committee, consisting of Dr. F. G. Cottrell, the director of the Bureau of Mines; Dr. Carl L. Alsberg, chief of the Bureau of Chemistry, and Andrew Stewart, of the Bureau of Mines. This committee will attempt to draft amendments which will meet the objections on the part of the chemical interests.

STATUS OF PENDING MINING LEGISLATION

Bills That Have Reached Committee Stage

Subject of Bill	*Bill No.*	*Author*	*Present Status*
Silver in coins	*H.R.* 11,226	*McFadden*	*Before House Committee*
Met. Min. on Ind. Res.	*S.* 287	*Ashurst*	*On Senate Calendar*
Timber for mining purposes	*S. No.* 1	*Pittman*	*Passed Senate Oct.* 3, *before House Committee*
Anti-dumping	*H.R.* 10,918	*Fordney*	*Passed House Dec.* 9, *on Senate Calendar*
Laboratory glassware	*H.R.* 7,785	*Bacharach*	*Passed House Aug.* 2, *on Senate Calendar*
Magnesite	*H.R.* 5,218	*Hadley*	*Passed House Aug.* 7, *on Senate Calendar*
Tungsten	*H.R.* 4,437	*Timberlake*	*Passed House Aug.* 21, *on Senate Calendar*
Zinc	*H.R.* 6,238	*McPherson*	*Passed House Sept.* 2, *on Senate Calendar*
War Minerals Relief	*H. R.* 13,091	*Garland*	*Reported favorably to the House March* 25.

(A bill slightly different to H. R. 13,091 passed the Senate June 1.)

NEWS BY MINING DISTRICTS

ALABAMA

Important Developments Under Way Looking to Larger Supply of Iron Ore

Birmingham—One of the most important mining projects in the Birmingham district in the last two years has been the development at depth of the Gulf States Steel Co.'s Shannon mines. Sinking of a slope has been under way for several years, and the ore has been struck recently. The operations have been slow, the slope being concreted as it went down. At a distance of 2,650 ft. a fine body of self-fluxing ore was struck. The ore is to be worked steadily and within twelve months it is expected that a daily output of 1,000 tons will be attained. The ore will average 68.26 per cent iron, the other constituents being 11.73 silicon, 3.31 alumina, 15.20 lime, 0.22 manganese and 0.29 sulphur.

The Woodward Iron Co. during the last two years has sunk a shaft and is now working a good body of self-fluxing ore on Red Mountain.

The Birmingham Ore & Mining Co. has an ore washing plant in operation at its Helen Bess mines, near Birmingham city limits, and the ore is being thoroughly washed. This is an independent company and no trouble is experienced in disposing of the product.

Discoveries of a rich vein of brown ore is reported in the vicinity of Mount Pinson, in the northern portion of Jefferson County, about 25 miles from the city. Borings have been made and the cores show good ore. The tests have not been extensive enough to warrant publication of results. Other ore beds in the state and over the Georgia line are also being tested. It is anticipated that there will be need for all iron ore offered.

Pig iron production in Alabama was increased during May by the blowing in of two blast furnaces and two more furnaces are scheduled to be started up in June.

Furnace repairing in the Birmingham district is being rushed and in every instance the best work possible is being done. It is also noted that all furnaces repaired produce more iron than previously. A peculiar find was made in the repairing of the blast furnace of the Gulf States Steel Co. at Gadsden, recently. It was discovered that some relining at the bottom would be necessary. A lot of about 300 tons of first-class iron was found that had leaked through the bottom.

The Sloss-Sheffield Steel & Iron Co. in repairing two furnaces added skip hoists, new cast sheds and other improvements that will make a fine showing when they are back in full operation.

ARIZONA

Construction of New Copper Queen Mill Progressing

Bisbee—The new Copper Queen mill below Warren is to have four 1,000-ton sections. Ore mined by steam shovels at Sacramento hill will be handled in ten-car trains by direct railroad to the mill, two miles distant, and will be dumped from the cars into a giant crusher, with jaw opening 5 x 7 ft. and capable of reducing a carload every two minutes down to 8-in. size. The ore will drop to two No. 9 gyratories, that will reduce it to 4-inch size, and thence to Symonds vertical disc crushers that will crush it to 1½ in. It will be weighed on the way to the storage bins.

Grinding will be done by rod mills, where water will be introduced. Roughing tables, which are expected to take out 40 per cent of the copper, follow in the flow sheet. The middlings, after regrinding, will go to flotation machines of the Callow pneumatic type, where 45 per cent of the original metal will be saved. The flotation tails will go to finishing tables, which are expected to make a further extraction of 3 per cent. The concentrates will be dewatered at the foot of the hill by Oliver filters. The ratio of concentration will be four to one and the average grade of the concentrates is expected to be between 7 and 8 per cent copper.

About 1,500,000 gal. of water a day will be obtained from the company's C. & C. shaft and an additional supply from the settling tanks. Power will be taken from the Copper Queen reverberatories at Douglas, over an electric line already in place. An emergency steam plant will be provided at the mill, with Diesel engines, two of 1,000 hp. and two of 2,000 hp. each. Only 60 men will be needed, two-thirds of them mechanics.

The mill is designed to handle about 16,500,000 tons of developed ores, sampling from 1 to 3½ per cent copper. Ores above the 3½-per cent grade will be crushed at the mill, but will then be delivered to cars for transportation to Douglas, for direct smelting. About 7,000,000 tons of still lower grade, not above 1 per cent, will be excavated by steam shovel. This is to have a special dump near Don Luis, where leaching processes will be tried in an endeavor to secure profit from it.

The Boras Leasing Company, during April, shipped to the Copper Queen smelter at Douglas 1,670 tons of ore averaging between 6 and 7 per cent copper.

The Night Hawk Leasing Co. has completed its shaft to the 750 level and is now drifting under its orebody on the 650 level.

The Wolverine & Arizona is at present confining all operations to development work.

Superior—Silver King of Arizona Mining Co.'s new three-compartment, vertical shaft is 635 ft. deep, and the 615-ft. level crosscut has been advanced 110 ft. to connect with the 600-ft. level station of the old shaft. The heavy flow of water, which flooded the new 6th level station when the old workings were tapped, has subsided and the level is now drained, and will be reopened and repaired. In the near future the sinking of the new shaft will be resumed, and probably continued to the 1,000-ft. level. The company will soon be in the market for additional power, compressor, and pumping units, essential to development and operation at greater depth. Development continues in the fourth ore shoot found in the 400-ft. level around the old ore chimney, and a fair grade of milling ore is being broken and held in reserve, pending resumption of milling operations in the near future. John Fowle is vice-president and general manager.

Phoenix—The Stene Consolidated Copper Co. is developing property in the extreme southeastern corner of Mohave County, Ariz., some of the claims being in Yuma County adjacent. The holdings include 785 acres, the main part of which is on a blowout of siliceous oxide and carbonate ore. The company claims to have proved thus far 275,000 tons of 2½ per cent copper ore carrying some gold and silver. One vein on the property is 2 ft. wide at the surface and 50 ft. wide 400 ft. below at a point where two tunnels have been driven in on it. There are also two promising conglomerate deposits on the property.

The ore is said to be available for leaching. An experimental leaching plant is planned. The company was organized to take over the property of the R. M. Stene Mines Co., Ltd., and to acquire the Oregonian group adjoining. R. M. Stene, Phoenix, Ariz., and 40 Wall Street, New York, is president of the company, and A. P. Dittmar general manager.

Sombrero Butte—In the 300-ft. level crosscut the Bunker Hill Copper Co. has cut a 10-ft. orebody 60 ft. from the shaft. Beyond this there is a smaller streak carrying high values in copper and silver.

Winkelman—Shipments of more than 6 tons daily are being made from the Antelope Peak Mining Co.'s property, which has been operated intermittently for about forty years, first for silver, later for copper. Present shipments contain 12 per cent copper and enough silver and gold to pay the freight. Mine workings reach over 400 ft. in depth. The vein is 6 to 7 ft. wide with 2½ ft. of shipping ore. The property is well equipped and development is being pushed vigorously. W. F. Hanny is in charge.

CALIFORNIA

Mountain Copper Buys Ground Adjoining

Redding—During the last few weeks many old mining companies have contracted to lease or to buy land adjoining their own property, and the latest of these deals was the purchasing of the Foresight, Oversight and Backsight claims by the Mountain Copper Co. The three properties lie in the Iron Mountain district near Redding, Shasta County, and all of them contain copper-bearing veins which are to be aggressively developed by the new management.

Hydraulic mining in the Siskiyou and Trinity fields has been greatly reduced due to water shortage, and several companies have been forced to cease all operations. The Roxbury company, operating near Scott's Bar, has made no attempt to produce but is centering all work on the Roxbury district, commanding the flow of the Milne, Andrews, San Jose and Whitehill creeks. The water that should be obtained from these creeks is thought sufficient to operate six large giants.

Portola — The construction of the eight-mile tramway, extending from the Walker copper mine to Spring Garden, is rapidly nearing completion. The purpose of the big tram is to eliminate shipping of concentrates by motor trucks from the mine to Gulling and thereby greatly to reduce the transportation costs. The plans include loading the buckets, after bringing the concentrates to Gulling, with merchandise to be taken back to the mine. Additions to the large flotation mill are being planned.

Minersville—The Fairview group has advanced its working tunnel near Minersville to about 800 ft. and it is expected that the main orebody will be tapped within 50 ft. more. The mine formerly ranked among the principal gold producers of Trinity County. The property is owned by Dunsmuir Gold Mining Co., composed mostly of railroad men.

Grass Valley—The high-grade vein encountered several weeks ago on the 400-ft. level of the Alcalde mine has been intersected on the 300-ft. level, where it continues to show quartz sprinkled with free gold. Five stamps are dropping and plans are now completed for the installing of five more in a few weeks.

Volcano—G. L. Sallada company, of Los Angeles, has acquired the Deadwood, Madrone and Dead Sheep quartz mines. The mines were worked in the early days by Mexicans who were successful in obtaining much rich gold ore before water forced them to discontinue work. The main ledge runs the entire length of the mines and averages two feet in width. It is stated that the new management will operate to considerable depth.

The adjoining Lowe property is producing steadily and keeping a mill busily engaged.

COLORADO

Road Conditions Improved in Ouray District—Camp Bird Continuing Development

Ouray—The Eurades Mining Co. has completed the bridge near the Micky Breen, has opened the road to pack travel, and will have wagons over the road in about ten days. The compressor plant is going up and work should start in a few weeks.

The Red Mountain-Silverton road is still blocked, but only a few slides and drifts remain. Traffic over this road will begin in about two weeks, through to Silverton.

The Paymaster Mines Co. has struck 4 ft. of good galena carrying silver; development is slow just at present owing to the condition of the Red Mountain road, but work will begin at this mine when the road opens.

The Silver Mountain Mines Co. is drifting on the Kentucky Giant vein with fair results. The upper workings on this vein have been cleaned out and ore is being hoisted from certain winzes.

Camp Bird continues developing at the new tunnel level, with results unknown to the public. It is evident that ore has been developed, as considerable has been stored in a large dump outside the tunnel separate from the waste dumps. It seems hardly likely that another season will pass without seeing resumption of milling, with possibly changes in the former flow sheet.

Fellin, Martini, et al, leasing on the El Mahdi, have developed a very good showing of excellent ore. About two feet of this ore runs around $100 per ton, mostly silver. This is one of the most substantial appearing strikes made here for some time and indicates the still big possibilities of the Bachelor district.

The Mountain Top Mining Co. has been steadily shipping high-grade silver-lead ore and concentrates. It is prepared to let a contract for several hundred feet of shaft sinking but is temporarily delayed by a recent heavy flow of water. Pumps are on the way for handling this water.

The Red Mountain Mines Co. has developed ore in several different headings in the Yankee Girl, Genesee and the other old Red Mountain mines under its control, and expects to be a heavy shipper this season when the railroad opens. Very likely the small mill will be operated again, probably with improvements.

IDAHO

Murray—The Monarch mill is being remodeled for the use of lessees on the Monarch mine. Several carloads of exceptionally high-grade lead-silver ore have been shipped from this property recently, and much good milling ore has also been developed. The Monarch is situated near Murray and is owned by the Fidelity company, the chief stockholders in which reside in St. Paul. Allen G. Kennedy, of Wallace, is manager.

MICHIGAN

Immigrants Arriving in Copper Country—Hancock Rock Below Grade Expected

BY HOMER GUCK

Calumet—For the first time in six years there is some evidence of the arrival of immigrants for the mines of the Michigan copper country. More are expected within six months. There are plenty of opportunities for them in the mines.

Quincy is building a crushing plant at the smelter. This will be utilized for the purpose of grinding up the brick that are taken from the inside of the furnaces. These brick become impregnated with copper after prolonged use.

Calumet & Hecla is extending its electric power lines for the purpose of carrying high voltage to the associated mines at the north end of the county. These lines are now being run from Laurium toward No. 4 Kearsarge and later on will go to the Ahmeek and the Allouez mines. The more general use of electric trams underground requires more power underground.

The same company continues to ship copper by rail, at the rate of three cars daily. Notwithstanding the fact that navigation has been open for 40 days, to date but two cargoes, totaling 10,000,000 lb., have gone forward by water.

The only construction work that the Calumet & Hecla is carrying forward at present is underground haulage on the conglomerate at the 83rd level. The flotation mill improvement and the proposed remodeling of the smelter plant have been held in abeyance owing to the difficulty in securing labor and the high cost of every material entering into the construction account.

The work of dismantling the Tamarack stamp mill will be undertaken this week and will be pushed rapidly. This mill was abandoned a year ago.

Houghton—In the New Baltic shaft of the Arcadian Consolidated property the crosscut on the 500-ft. level back to the vein is well under way, following the unwatering of the shaft. There is reason to believe that the vein will be tapped within a week, if the present rate of progress is maintained. On the 400-ft. level, where the showing of copper was so spectacular, work will be resumed at once. Arcadian had a little trouble getting coal but this problem has been solved, temporarily at least.

There has been no improvement in the underground developments at the Hancock mine. Operations in the last few months have been in a "rock" the character of which is not up to expectations. There is hope that two of the formations which now are being opened may improve with further opening, but beyond that hope there is the cold fact that the milling "rock" is not high grade and nothing but opening on a very large basis could make it possible to operate the mine at a profit.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Waco—Rapid progress is being made by the Butte-Kansas Mining Co. in erecting a new mill to take the place lost by a cave-in following the heavy rain and wind storms of May 3-4. The new mill is being constructed a short distance to the north of the one lost, and will be almost an exact duplicate of it. This company has lost two mills, the first one being completed late in December, 1917, and had only been in operation a few days when it was totally destroyed by fire of unknown origin. This was on Christmas day, 1917. Another mill was decided upon and was completed the following summer, and the mine has been a steady producer for many months. L. P. Buchanan, of Joplin, is managing director of the property.

Carterville—The shortage of miners in Webb City and Carterville is so great now that the operators of the American Zinc, Lead & Smelting Co.'s Davy mine at Carterville are giving machine shovels a try-out. Where 60 shovelers were needed recently only twelve reported for work.

MONTANA

Butte—The labor situation in the mines of the Anaconda company continues poor, with an undercurrent of antagonism in evidence. The company is continuing its policy of barring employment to the I. W. W. As an example of the curtailment the Badger State, one of the larger mines of the Anaconda, is shipping daily only about one-third its normal tonnage.

Shipments from the Davis Daly's Hibernia mine have been increased to 100 tons daily. The new ore-sorting device recently installed is effecting a saving of about $100 daily and the employment of gasoline locomotives instead of horses for surface tramming of ore about $500 monthly. The labor turnover is often averaging 50 per cent a month.

A statewide movement to appeal to Congressmen to enact legislation providing for an excise tax on gold has been started by the Barnes-King Development Co., one of the principal gold producers of Montana. If relief is not granted, gold production in Montana, aside from that had in association with copper mining, will come to an absolute stop.

Plans are progressing, it is understood, for the merging of the properties of the Butte-Bullwacker and the Butte-Duluth copper companies, both of which are being operated by common interests. Shipments being made from both properties to the leaching plant of the Anaconda company.

Clancy—The Legal Tender Consolidated has shut down and the plant is being dismantled. This property has been a great disappointment.

Arrangements are being made by the Liverpool company for treatment of low-grade ore at the plant at Helena of the New York-Montana T. & E. Co.

NEVADA

Tonopah-Divide Installs New Hoist—Labor Conditions Improving

Tonopah — Reported bullion shipments for first cleanup in May, representing about two weeks' operation, indicate a gross production from the district for May at about $500,000. Labor conditions are fair, and there appears to be less of the "strike on the job" spirit than previously.

Divide—The Tonopah Divide has installed a larger and more modern hoist with hoisting speed of 600 ft. per minute. Development work has been carried on on the 365, 470 and 585 levels. On the last, or 585 level, the east drift is reported to have made a total advance from the shaft crosscut of 668 ft., with the last ten feet in ore of milling grade. It is stated that this ore is of a different character than that of the upper levels, being more siliceous and containing excessive pyrite.

Austin—In *Engineering and Mining Journal* of April 17 it was stated that "increasing interest is manifested on the Wedekind lease on the Herschell Consolidated close to the depot at Austin, where ore averaging 70 oz. silver and 40 per cent lead was found on the surface and is holding out with development. The property is in what is called the base-metal zone of the district." The item concluded by stating that "George D. Kilborn, of Reno, is developing the property" which was incorrect. Any credit for re-opening this old property, discarded for forty years, is due the present owner, E. H. Wedekind, who has paid all expenses out of his own pocket.

WASHINGTON

Keller—The Iron Creek Mining Co. is pouring concrete for the foundations of a 25-ton experimental mill, the machinery for which is ready on the ground. The mill is expected to be in operation within a few months. The Illinois Copper Mining Co. is preparing to resume operations.

Orient—The First Thought Extension Mining Co. reports that it has encountered a gold quartz vein in its new shaft, which may be an extension of the First Thought vein.

MEXICO

Sonora

Considerable satisfaction is expressed among mining operators in southern Sonora due to the fact that the difficulties between the Government and the Yaquis have apparently been settled for the time being. Many of the Indians have taken up arms with the new revolutionary party and reports from the southern part of the state advise that everywhere there is quiet.

Owing to the death of the principal owner of the Buena Vista Mining Co. work at the property near Lampazos has been stopped temporarily.

Plans are being made to increase the capacity of the Progresso mill. Hauling by trucks is now being done from Nacozari to Progresso via Cumpas and Moctezuma, whereas formerly a road from the property to Hermosillo via Colorado was used. After the killing of W. Tovote, mining engineer, and the burning of the Progresso company's trucks, Superintendent A. McFarlane built the new road north, connecting with the Moctezuma-Cumpas road to Nacozari. The new road entirely avoids the country where Yaqui raids are likely.

Guanajuato

Guanajuato—Owing to the recent political disturbances in the country, operations in the Guanajuato district have been more or less curtailed. On May 6, the Federal garrison revolted, turning over to the revolutionary forces but without bloodshed. Demands were made by the revolting soldiers for arms and horses which resulted in a loss to several of the mining companies of horses, saddles and arms of their watchmen, especially at their properties lying outside the city. Train service was discontinued from this date until May 11, thereby seriously hampering work through causing a lack of supplies, a trainload of cyanide and other material having been held up in transit.

By reason of inability to obtain supplies because of political disturbances, the Guanajuato Consolidated M. & M. Co. was forced to shut down its 80-stamp, 250-ton mill in the city of Guanajuato. A small force of men is being kept at work in the mine and mill and as freight service has been resumed, operations are expected to start by May 23 (written May 17).

Carmen—The 10-stamp, 50-ton mill of Carmen-Guanajuato Gold Mine Co., which is a subsidiary of the Guanajuato Consolidated M. & M. Co., has ceased operations owing to political disturbances.

Santa Ana—The aerial tramway being erected to carry ore from the mines of the Esperanza Mines Co. to the San Matias mill of the Guanajuato Development Co. in Guanajuato, to which they belong, is nearly completed, as well as repairs to the mill. Conditions permitting, operations are expected to begin by the end of June. H. C. Field is in charge of construction.

Peregrina—Operations at the mill of the Peregrina Mining & Milling Co. have been slightly curtailed for the last two weeks but are expected to be resumed in full with the resumption of freight service from Guanajuato to the main line of the railroad at Silao.

Chihuahua

Parral—El Refugio mining company is building a 200-ton cyanide plant and installing large pumps. The mine is now being unwatered. Equipment for electric haulage is arriving at the mine. Several adjoining properties have been purchased. The mill being built is intended as the first unit of a large plant. Table concentration will precede cyaniding. The ore is silver-lead sulphide.

THE MARKET REPORT

Published in part in San Francisco and mailed from there to our Western subscribers as a special service without charge pending the arrival of the *Engineering and Mining Journal*

Silver and Sterling Exchange

May	Sterling Exchange	Silver		May	Sterling Exchange	Silver	
		New York, Cents	London, Pence			New York, Cents	London, Pence
27	386½	102	59⅜	31	....	....	57⅝
28	389	100	57⅞	June 1	387½	99½	57⅝
29	386	99⅝	57¾	2	394	99⅝	57

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Daily Prices of Metals in New York

May	Copper	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
27	18.15	49.50	51.50	8.50	8.35	7.40
28	18.25	50.00	52.00	8.50	8.45	7.45
29	18.25	50.00	51.50	8.50	8.45	7.50
31	.....	.....	.....	....	....	....
June 1	18.35	49.50	51.25	8.50	8.50	7.55
2	18.35	50.25	50.75	8.50	8.50	7.50

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for prompt and nearby deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point. All prices are in cents per pound.

Copper is commonly sold on terms "delivered," which means that the seller pays the freight from refinery to buyer's destination. The delivery cost varies, and it would be confusing to figure net prices on individual transactions. Consequently, an average deduction is made from the "delivered" price. At present the average cost of delivery from New York refineries is 0.15c. per lb., and that deduction is made to arrive at the New York price. When copper is sold f.o.b. or f.a.s. New York, of course no deduction is made.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
27	91⅜	95½	105	270½	277½	38½	39¾	43¼	45½
28	93½	96½	105	274½	280½	38½	39½	43¾	46
29	....	....	....	....	....	....	....	....	....
31	95	98½	105	274½	280	39	40	44	46¼
June 1	96¼	98½	106	272½	279½	39	40	44¼	46½
2	95	98	106	273¾	280½	38	39¼	43½	45¾

The above table gives the closing quotations on the London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb.

Metal Markets

Monthly Average Prices for May

Copper:	
New York Electrolytic	18.484
London Standard	96.750
London Electrolytic	109.200
Lead:	
New York	8.576
St. Louis	8.352
London	38.488
Silver:	
New York	102.585
London	60.010
Sterling Exchange	383.360
Zinc:	
New York	7.938
St. Louis	7.588
London	45.088
Tin:	
99 per cent	53.230
Straits	55.100
London	294.813

New York, June 2, 1920.

A slightly more optimistic feeling is in evidence among the metal producers with the gradual improvement in transportation. Copper, lead, and zinc all exhibited a firmer tendency, although sales have, in general, been small. Tin is still unsettled.

Copper

The buying movement expected this month has not yet really begun, although sales were larger last week than for some time, in spite of the holiday. A firmer tone has existed for the last two or three days, as small lots in the hands of traders have been pretty well disposed of. Business continues inactive with the larger producers.

Japanese copper is still hanging over the market. Some was sold last week for 17½c., New York, and yesterday and today quantities up to 1,000 tons are being offered for immediate shipment from Japan at 18c. or less. This is all American copper. The Japanese interests are also reported to have some which has not yet been shipped from this country. This may be a strategic move to depress the price preparatory to buying a little later. If so, it seems doomed to failure.

The Copper Export Association has arranged to sell copper on credit to some of its European clients over a period of two years. The price is to be fixed from time to time as purchases are made against these credits. The association will draw on the buyers, with documents attached, the drafts payable three months following shipment, which will be accepted by the buyers against surrender of documents. The financial and commercial standing of the buyers will in itself assure the payment of the drafts. In addition to this security, the buyers have arranged that European banks of the highest standing guarantee payment of the drafts at maturity.

The arrangement provides that buyers have the right to two renewals of the original draft at intervals of three months, so that ultimate payment may be deferred for nine months following shipment. The drafts carry interest from date of shipment to date of payment. The association confidently expects that this arrangement will result in a large increase in business as soon as the present chaotic conditions abroad are removed.

Lead

Small lots of prompt lead continue in demand, though inquiries have not been as active during the last week. Scarcity in the Middle West has caused the St. Louis price to equal that of New York. The large producers expect a scarcity of lead this summer and fall and expect prices to go up rather than down. They consider that the bears did their worst in May. But little business is being done in futures, though August and September deliveries can be had at 7¾c. St. Louis. There is some talk that Japan will try to sell lead as well as copper, though no offers have yet been made.

Zinc

Indications point to the fact that the bottom has been reached in the zinc market, and a slight increase in price is evident. The movement cannot progress far with London stagnant around £44 and ample supplies reported. Few sales have been made locally, and the market is still anything but active.

Tin

Continued decline and want of real recovery in London have made the market unsatisfactory. Little business is

being done. Ninety-nine per cent is selling for almost the same as the better-grade Banca tin. A rather large supply of the latter has been released, which has reduced the price. Tin users prefer the brand with which they are familiar, even though an equally high-grade article may sell cheaper for the time being.

Straits tin for future delivery: May 27, 50@50½c.; May 28, 50½@51c.; May 29, 50@50½c.; June 1, 50½@51c.; June 2, 50½@51c.

Arrivals of tin in long tons: May 26, Singapore, 50. Total for May, 6,230. June 1, Hongkong, 50; Rotterdam, 100.

Silver

The demand for China direct shipment having fallen off, silver declined to 99½c. New York delivery and also for San Francisco. The large transfers of coin-bars from the Continent, and of silver coin itself for the London refineries, have satisfied the English market and explain the lack of inquiry here for that quarter.

Mexican Dollars: May 27, 78c; May 28, 76½c.; May 29, 75⅞c.; June 1, 75⅞c.; June 2, 75⅞c.

Gold

Gold in London on May 27, 106s. 6d.; May 28, 105s. 8d.; May 31, 106s. 3d.; June 1, 106s. 3d.; June 2, 104s. 10d.

Foreign Exchange

The principal feature of the week has been the pronounced rise in sterling. Marks have declined sharply, indicating that the speculative interest was large. On Tuesday, francs and lire, in units to the dollar, were 12.86 and 16.88 respectively. German marks were 2.59c. and New York funds in Montreal, 12⅝ per cent premium. The Canadian war duty of 7½ per cent on practically all imported merchandise has been removed.

Other Metals

Aluminum—Ingot is quoted at 33c. per lb., with 31½@32½c. open market for 98@99 per cent virgin; quiet. Unchanged.

Antimony—Market slightly weaker and dull, with tendency to shade prices. Spot, 8¾@9¼c. per lb.; Cookson's "C" grade, 14¾c. Chinese and Japanese brands, easy, 8¾@9¾c., but no demand.

[1]**Needle Antimony** — The market for Chinese needle antimony in lump form is firm at 9½c. per lb., although demand continues quiet. Standard powdered needle antimony (200 mesh) is quoted at from 12 to 15c. per lb. according to quantity. Unchanged.

Bismuth—Unchanged at $2.70@$3 per lb. for 500-lb. lots.

Cadmium—Quoted nominally at $1.40 @$1.50 per lb. Some metal may be had as low as $1.20 per lb. Unchanged.

[1]**Cerium Metal** — There has been no change from the price of $8@$9 per lb. in ingot form.

Cobalt—Metal remains unchanged at $2.50@$3 per lb. Black oxide, $2 per lb.

Iridium—Metal scarce at $300 per oz., but no business.

Magnesium—Metallic, 99 per cent or over pure, $1.60@$1.85 per lb. Unchanged.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, is still selling at $32@$40 per lb., according to gage.

Nickel—Ingot, 43c.; shot, 43c.; electrolytic, 45c; Monel metal, shot, 35c; blocks, 35c., and ingots, 38c. per lb.

Osmium—Open market prices, $50@ $75 per troy oz.

Palladium—Quoted at $80@$85 per oz. Market dull and weaker.

Platinum—Market weaker at $85@ $90 per oz. Business very dull.

Quicksilver—Market fairly steady, at $80 per 75-lb. flask. San Francisco wires $80; steady.

Ruthenium—Market value, $200@ $220 per troy oz. Unchanged.

[1]**Selenium**, black, powdered, amorphous, 99.5 per cent pure, continues to be quoted at $1.75@$2 per lb., depending on quantity.

[1]**Thallium Metal**—Selling at $18@$20 per lb., ingot, 99 per cent pure, depending on quantity.

Metallic Ores

Chrome Ore—Current price of chrome ore on the basis of Cr_2O_3 varies with the sesquioxide contained. The guaranteed 50 per cent foreign ore with a minimum of 6 per cent silica ranges from 72c. to 80c. per unit, New York. California concentrates, 50 per cent Cr_2O_3 and upward, 60@65c. per unit, f.o.b. mines. Unchanged.

Iron Ores—Lake Superior ores, per ton delivered at Lower Lake ports: Old Range bessemer, $7.45; Old Range non-bessemer, $6.70; Mesabi bessemer, $7.20; Mesabi non-bessemer, $6.55. Lake shipments are increasing and more boats are going into commission.

Manganese Ore—Market quiet, with high-grade ore quoted 80@85c. per unit. Chemical ore (MnO_2) quoted at $80@$90 per gross ton. Unchanged.

Molybdenum—No business; market unchanged. Quoted nominally at 75c. per lb. of contained sulphide for 85 per cent MoS_2.

[1]**Tantalum Ore**, guaranteed minimum 60 per cent tantalic acid, is still selling at 65@70c. per lb. in ton lots.

Titanium Ores.—Ilmenite, $20 per ton for ore containing 52 per cent TiO_2 Unchanged. Rutile, standard imported Norwegian grade, carrying a minimum of 95 per cent titanium dioxide, in the form of concentrates, is quoted at 11c. per lb.

Tungsten Ore—Chinese wolframite continues to be quoted $6.50@$7 per unit. Bolivian spot is offered nominally at $8.50@$9 per unit. A California producer informs us that he has large stocks of scheelite but cannot afford to sell in competition with imported ore. He states that he should receive not less than $15 per unit, but has made no quotations.

Uranium Ore (Carnotite)—$2.75@$3 per lb. for 96 per cent of the contained oxide (U_3O_8). Ores must contain a minimum of 2 per cent U_3O_8.

Vanadium Ore—Prices are usually based on vanadium content, and at present range from $1 to $3 per lb. of contained vanadium. Variation also depends on presence of lead, copper, arsenic, molybdenum, uranium, etc.

Zircon—Washed, iron free, continues to be quoted at 10c. per lb. Zirkite—In carload lots, $90@$100 per ton is quoted. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., May 29.—Zinc blende, per ton, high, $47.90; basis 60 per cent zinc, premium, $45; Prime Western, $43.50@$42.50; fines and slimes, $41@ $37.50; calamine, basis 40 per cent zinc, $36. Average settling prices: Blende, $44.90; calamine, $37.55; all zinc ores, $44.75.

Lead, high, $105.40; basis 80 per cent lead, $100; average settling prices, all grades of lead, $102.90 per ton.

Shipments for the week: Blende, 9,463; calamine, 188; lead, 1,845 tons. Value, all ores the week, $621,760.

Shipment for five months: Blende, 262,753; calamine, 4,377; lead, 40,270 tons. Value, all ores five months, $17,747,240.

Buying orders for blende were light and prices seemingly weak, but on Friday additional orders were received and the market strengthened, retaining the advance of the previous week. Buying this week exceeded the production by from 2,000 to 3,000 tons. Transportation tangles keep the shipments lower than the purchases, and the tonnage of unsold ore is dwindling.

Platteville, Wis., May 29—Blende, basis 60 per cent zinc, $47@$49 per ton for high grade. Lead ore, basis 80 per cent, $100 per ton. Shipments reported for the week: Blende, 888; calamine, 120; lead, 160; sulphur ore, 82 tons. Shipments for the year: Blende, 30,612; calamine, 1,860; lead, 2,876; sulphur ore, 596 tons. Shipped during week to separating plants, 2,232 tons.

Non-Metallic Minerals

Asbestos—Quoted per short ton f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada. Freight rate from mines to Sherbrooke, Quebec, over Quebec Central R.R., 20c. per cwt; from Sherbrooke to New York, 27½c., carload lots. Crude No. 1, $1,800@ $2,500; crude No. 2, $1,100@$1,500; spinning fibres, $400@$700; magnesia and compressed sheet fibres, $300@ $400; shingle stock, $100@$150; paper stock, $60@$80; cement stock, $17.50@ $30; floats, $8.50@$15 per short ton. Crude No. 1, f.o.b. Thetford Mines, freight to New York $8.45 per ton in carload lots. Five per cent Canadian royalty export sales tax must be added to these prices.

Barytes—Crude, 88 to 94 per cent barium content, $8@$10 per net ton; ground, (white) $20@$22 in bags, carload lots; (off-color) $16@$18 in bags, carload lots; all prices f.o.b. Kings Creek, S. C. Prices f.o.b. Cartersville, Ga., are $23@$25 per net ton for ground, white; $16@$19 for ground off-color; $12 per gross ton for crude, 88@94 per cent.

Chalk—English, extra light, 5@7c. per lb.; light, 5@6c. per lb.; dense, 4@5c. per lb., f.o.b. New York. Unchanged.

China Clay (Kaolin)—Imported lump, $25@$35 per ton; imported powdered, $30@$60 per ton; domestic lump, $10@$20 per ton; domestic powdered, $25@$40 per ton, f.o.b. New York.

Feldspar—Crude, $7.50@$8 per gross ton, f.o.b. Maryland and North Carolina points; ground, $18@$25, car lots, f.o.b. Baltimore.

Fluorspar—Ohio district: prompt, $28 per ton; contract, $23@$25 per ton.

Fuller's Earth—Remains firm at $25@$30 per ton for domestic and $35@$40 for foreign, with little material available at these prices.

Graphite — Present quotations for crucible flake are: 80 per cent carbon content, 5c. per lb.; 90 per cent, 7@9c.; 30 per cent (dust polish grade) 1c.; 50 per cent (dust facing grade) 1½c., f.o.b. Ashland, Ala. Mexican amorphous graphite is being sold at $55@$60 per short ton; Korean, 3¾c. per lb.; Madagascar, 9c.; Ceylon, 4¾@16c., according to quality. Unchanged.

Gypsum—Wholesale price, plaster of paris in carload lots, is $3.75 per 250-lb. bbl., alongside dock New York.

Kaolin—See China Clay.

Magnesite—Dead burned, for refractory (see Refractories).

Magnesite, Calcined — High-grade caustic calcined, in lump form, is selling at $35@$40 per ton in carload lots f.o.b. California points. The price of freshly ground calcined, suitable for the flooring trade, is $65@$75 per ton f.o.b. Eastern points.

Mica—No change in prices per lb. for sheets slightly stained and for clear mica according to grade: No. 6, 50c.; No. 5, $1.20@$1.40; No. 4, $2@$3; No. 3, $4.25@$5; No. 2, $5.50@$7; No. 1, $8; all prices f.o.b. New York.

Monazite—Product carrying a minimum of 6 per cent thorium oxide, $42 per unit is quoted, duty paid.

Phosphate Rock — Prices quoted per long ton at Florida ports are: 68 per cent tricalcium phosphate, $6.85; 70 per cent, $7.35; 74 to 75 per cent, $10; 75 per cent minimum, $10.50; 77 per cent cent minimum, $12.50. No offerings.

Pumice Stone—Imported, 3@6c. per lb.; domestic, 2½c. per lb. Unchanged.

Pyrites—High prices paid by foreign consumers are holding down imports of this mineral. Spanish furnace size ore has sold at 16½c. Freights range from 15s. to 17s. No change in domestic situation.

Sulphur—Demand is good and prices average $18 per ton for domestic, and $20 for export, f.o.b. Texas and Louisiana mines.

Talc—Prices f.o.b. Vermont are $9.50@$14 per ton, paper making; roofing grades, $8@$9; rubber grades, $9@$15. California talc sells for $20@$35, talcum powder grade.

Mineral Products

Arsenic—White arsenic, 16@19c. per lb.; sulphide, powdered, 20@21c. per lb., f.o.b. works.

Nitrate—Soda quoted at $3.85 per cwt., ex vessel, Atlantic ports. Futures are quoted $3.90@$4.10. Double refined, granulated, 5¾c. per lb.; powdered, 7¼c.; crystals, 6¼c., f.o.b. New York. Potash nitrate, granulated, 14c. per lb.; crystals, 15c.; powdered, 15c.; f.o.b. New York.

Potassium Sulphate—Domestic, $200 per ton. German, at New York, same price.

Ferro Alloys

Ferrocarbontitanium—For 15-18 per cent material, $200@$250 per ton f.o.b. Niagara Falls, N. Y. Unchanged.

Ferrocerium[1]—Conditions abroad continue to cause a reduction in price of the American goods, and this alloy is now selling at $12@$15 per lb.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 4 to 6 per cent carbon, 18@19c. per lb. of chromium contained.

Ferromanganese—Domestic, 76 to 80 per cent, delivered, $200@$225 per ton for futures; car lots, spot, $225@$250 per ton; small lots, $275. English, c.i.f. tidewater, $195, last half delivery. Spiegeleisen—Spot prices remain at $72.50@$75 per ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, are quoted at $2.25@$2.75 per lb. of contained metal.

Ferrosilicon — Electrolytic, 50 per cent, delivered, $78@$80 f.o.b. Buffalo; 75 per cent, $150, delivered, Pittsburgh, Valleys, Cleveland. Bessemer, 10 per cent, $62.50; 11 per cent, $65.80; 12 per cent, $69.10, f.o.b. furnaces at Jackson and New Straightsville, Ohio. All prices, per ton.

Ferrotungsten—Unchanged at 85c@$1.15 per lb. contained tungsten.

Ferro-uranium—35-50 per cent U, $7 per lb. of U contained. Unchanged.

Ferrovanadium—Basis 30-40 per cent, $6.50@$7 per lb. of V contained.

Metal Products

Copper Sheets—No change in Jan. 7 price of 29½c. per lb.; wire, quoted 22½@23c.; market still strong.

Lead Sheets—Full lead sheets, 12½c.; cut lead sheets, 12½c. in quantity prices, mill lots. Unchanged.

Nickel Silver—Unchanged at 39½c. per lb. for 18 per cent nickel.

Yellow Metal — Dimension sheets, 26¾c.; sheathing, 25¾c.; rods, ⅝ to 3 in., 23¾c. Unchanged.

[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc Sheets—$12.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 12c. per lb. Unchanged.

Refractories

Chrome Brick—Unchanged at $70@$75 per net ton, f.o.b. Chester, Pa.

Chrome Cements—Unchanged at $45@$50 per net ton, f.o.b. Chester, Pa.

Clay Brick — First-quality fire clay, $45@$50 per 1,000, f.o.b. Clearfield, Pa.; second quality, $40@$45 per 1,000, f.o.b. Clearfield, Pa.

Magnesite — Dead burned, $48@$55 per net ton, f.o.b. Chester, Pa.; brick, 9 x 4½ x 2½ in., $90@$95 per net ton, f.o.b. Chester, Pa. Dolomite is selling at $12.50 per ton, f.o.b. Ohio.

Silica Brick—$50@$55 per 1,000, f.o.b. Mount Union, Pa.

Iron Trade Review

Pittsburgh, June 1, 1920

Mills are not shipping as much steel as they make, but that point may be reached in a fortnight or so. Mills are more concerned about moving their accumulation of steel than increasing the rate of production, which remains at 75 to 80 per cent of capacity.

The iron and steel markets continue stagnant. Buyers regard steel prices above the Steel Corporation or Industrial Board level as distinctly premium prices for delivery and are therefore indisposed to take hold except to cover absolute necessities. The Steel Corporation has advanced its Canadian prices $20 a ton over the Industrial Board schedule on sheets and tin plate and $2 on bars, shapes, and plates, but shows no disposition to depart from the Board schedule for the United States.

Pig Iron—Nothing is being done except in small lots for prompt shipment, there being practically no second-half market. Prompt bessemer has sold at 50c. advance. We quote: Bessemer, $43; basic, $43.50; foundry $45, f.o.b. Valley furnaces, freight to Pittsburgh being $1.40.

Steel—The market is quiet, but with occasional inquiry for sheet bars. We quote: Billets, $60@$65; sheet bars, $70@$75; rods, $70@$75.

Charcoal and Coke

Charcoal — Large quantities sell as follows: Willow, 7c. per lb.; hardwood, 4½c. per lb., in 250-lb. bbl.

Buffalo—For 72-hour Connellsville foundry, $15; for 48-hour furnace, $13.50 per ton.

Connellsville—Market stiffer. Prompt furnace, $14.50@$15.50; prompt foundry, $15.50@$16.50; contract foundry, $11@$12 per net ton at ovens. Nominal.

New River—Furnace, $11.50@$12.50, and foundry, $13@$14 per ton.

Pocahontas—Furnace, $12@$13 per ton.

Wise County—Furnace, $12@$14 per ton; foundry, $12@$14 per ton.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York			London		
	1918	1919	1920	1918	1919	1920
January	88.702	101.125	132.827	44.356	48.438	79.846
February	85.716	101.125	131.295	42.792	48.027	85.005
March	88.082	101.125	125.551	43.620	48.171	74.194
April	95.346	101.125	119.779	47.215	48.886	68.848
May	99.505	107.135	102.585	48.980	52.104	60.010
June	99.500	110.430	.....	48.875	53.896	.....
July	99.625	106.394	.....	48.813	54.133	.....
August	100.292	111.370	.....	49.077	58.835	.....
September	101.125	114.540	.....	49.500	61.668	.....
October	101.125	119.192	.....	49.500	64.049	.....
November	101.125	127.924	.....	48.969	70.065	.....
December	101.125	131.976	.....	48.492	76.432	.....
Year	96.772	111.122	.....	47.516	57.059	.....

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		(b) Electrolytic	
	1919	1920	1919	1920	1919	1920
January	(a)	18.918	92.238	118.095	106.619	123.238
February	16.763	18.569	78.700	120.188	95.700	126.950
March	14.856	18.331	76.821	109.533	82.071	118.348
April	15.246	18.660	77.300	103.025	82.200	111.500
May	15.864	18.484	77.767	96.750	81.227	109.200
June	17.610	.....	83.062	.....	85.900	.....
July	21.604	.....	99.576	.....	103.046	.....
August	22.319	.....	97.300	.....	106.429	.....
September	21.755	.....	100.767	.....	.....	.....
October	21.534	.....	103.418	.....	.....	.....
November	19.758	.....	98.894	.....	.....	.....
December	18.295	.....	103.708	.....	.....	.....
Year	18.691	.....	90.796	.....	.....	.....

(a) No market. (b) See note on page 1289.

Lead

	New York		St. Louis		London	
	1919	1920	1919	1920	1919	1920
January	5.432	8.561	5.316	8.300	37.227	47.095
February	5.057	8.814	4.784	8.601	28.675	50.256
March	5.226	9.145	4.992	8.894	27.952	46.054
April	4.962	8.902	4.722	8.618	24.888	39.225
May	5.018	8.576	4.773	8.352	23.852	38.488
June	5.340	.....	5.070	.....	22.544	.....
July	5.626	.....	5.408	.....	23.457	.....
August	5.798	.....	5.583	.....	25.330	.....
September	6.108	.....	5.853	.....	28.473	.....
October	6.487	.....	6.249	.....	34.731	.....
November	6.808	.....	6.649	.....	41.202	.....
December	7.231	.....	6.955	.....	.....	.....
Year	5.759	.....	5.530	.....	28.590	.....

Tin

	New York				London	
	1919		1920			
	99%	Straits	99%	Straits	1919	1920
January	67.702	.....	61.596	.....	248.557	376.512
February	66.801	.....	58.466	59.932	223.963	395.750
March	67.934	.....	61.037	61.926	236.843	369.489
April	72.500	.....	61.120	62.115	225.275	345.450
May	72.500	.....	53.230	55.100	234.398	294.813
June	71.240	.....	.....	..	238.263	.....
July	68.000	.....	.....	.....	253.272	.....
August	57.226	.....	.....	.....	273.625	.....
September	54.482	.....	.....	.....	280.102	.....
October	54.377	.....	.....	.....	279.239	.....
November	53.307	.....	.....	.....	283.556	.....
December	53.870	.....	.....	.....	314.113	.....
Av. year	63.328	.....	.....	.....	257.601	.....

Zinc

	New York		St. Louis		London	
	1919	1920	1919	1920	1919	1920
January	7.272	9.483	6.922	9.133	56.045	58.643
February	6.623	9.058	6.273	8.708	46.150	61.338
March	6.500	8.881	6.150	8.531	38.500	53.467
April	6.465	8.534	6.114	8.184	36.118	47.388
May	6.429	7.938	6.079	7.588	35.477	45.088
June	6.901	.....	6.551	.....	36.763	.....
July	7.873	.....	7.523	.....	41.815	.....
August	7.789	.....	7.160	.....	39.338	.....
September	7.510	.....	7.473	.....	40.955	.....
October	7.823	.....	7.827	.....	43.630	.....
November	8.177	.....	8.350	.....	46.588	.....
December	8.700	.....	8.350	.....	53.101	.....
Year	7.338	.....	6.988	.....	42.879	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron, Pittsburgh

	Bessemer ‡		Basic ‡		No. 2 Foundry	
	1919	1920	1919	1920	1919	1920
January	$33.60	$40.47	$31.40	$39.88	$32.40	$39.86
February	33.60	42.954	31.40	42.61	32.40	43.40
March	32.54	43.40	31.40	42.90	29.12	43.40
April	29.35	43.72	27.15	44.22	28.15	43.90
May	29.35	.....	27.15	.....	28.15	.....
June	29.35	.....	27.15	.....	28.15	.....
July	29.35	.....	27.15	.....	28.15	.....
August	29.35	.....	27.15	.....	28.15	.....
September	29.35	.....	27.15	.....	28.15	.....
October	29.35	.....	27.15	.....	28.30	.....
November	31.60	.....	31.56	.....	32.16	.....
December	36.57	.....	35.32	.....	36.86	.....
Year	$31.11	.....	$29.26	.....	$28.35	.....

‡ As reported by W. P. Snyder & Co.

Monthly Copper Production

The table which appears herewith represents the crude-copper content of blister copper, in pounds.

MONTHLY CRUDE COPPER PRODUCTION, 1920

	January	February	March	April
Alaska shipments	7,909,682	5,121,609	4,897,088	6,507,515
Arizona:				
Arizona Copper	3,000,000	3,000,000	3,000,000	3,000,000
Calumet & Arizona	5,034,000	5,268,000	4,428,000	3,176,000
Cons. Ariz. Smelting	690,000	910,000	1,250,000	1,200,000
Inspiration	7,200,000	7,200,000	6,500,000	6,000,000
Magma	707,585	729,546	830,235	895,082
Miami	4,461,247	4,089,520	4,091,535	4,924,420
New Cornelia	2,456,000	2,872,000	3,408,000	3,560,000
Old Dominion	2,504,900	2,103,000	2,358,000	2,180,000
Phelps Dodge	5,622,000	5,535,500	6,145,000	5,700,000
Ray	316,970	340,384	344,938	214,122
Shattuck Arizona	3,899,073	3,885,000	3,900,000	4,500,000
United Verde	6,550,000	6,490,000	5,900,000	5,300,000
United Verde Extension	3,676,312	2,977,898	3,977,898	3,270,718
Michigan:				
Calumet & Hecla	9,690,671	8,660,052	9,880,577	9,532,476
Other Lake Superior	6,420,000	6,420,000	6,420,000	6,420,000
Montana:				
Anaconda	18,100,000	18,500,000	18,450,000	15,800,000
East Butte	1,738,840	1,460,360	1,909,720	1,291,840
Nevada:				
Nevada Cons.	4,181,938	3,850,000	3,700,000	4,140,000
New Mexico:				
Chino	3,081,937	3,176,489	4,413,329	3,543,471
Utah:				
Utah Copper	8,693,589	9,211,806	8,894,596	9,313,227
Eastern Smelters	1,610,000	1,600,000	1,610,000	1,610,000
Total reported	107,544,744	103,401,164	106,309,316	102,018,871
Others, estimated	14,359,000	14,049,000	14,000,000	14,000,000
Total United States	121,903,744	117,450,164	120,309,316	116,018,871
Imports: Ore and concentrates, etc	13,372,187	10,848,782	9,766,336	.....
Imports in blister, etc	20,852,050	28,319,347	19,108,437	.....
Grand total	156,127,981	156,618,293	149,184,089	.....
British Columbia:				
Granby Cons.	1,975,439	2,180,000	2,095,500	2,105,400
Mexico:				
Boleo	1,054,550	911,051	1,193,416	1,063,168
Cananea	3,000,000	3,400,000	3,700,000	4,000,000
Phelps Dodge Mexican properties	2,340,000	2,050,000	1,786,000	2,098,000
Other foreign:				
Cerro de Pasco	4,616,000	4,718,000	5,658,000	3,942,000
Chile	7,508,000	.....	9,256,000	8,172,000
Katanga	4,519,430	4,133,625	3,229,739	.....
Backus & Johnston	716,000	926,000	958,000	1,354,000

Production of the United States by months since the beginning of the year and the corresponding figures for 1918 and 1919 were as follows:

	1918	1919	1920
January	165,431,568	135,733,511	121,903,744
February	160,011,364	111,649,512	117,450,000
March	185,525,168	102,040,460	120,309,316
April	163,207,096	98,808,998	116,018,871
May	181,070,350	92,652,975	.....
June	166,723,599	95,856,570	.....
July	159,329,031	100,369,247	.....
August	165,550,799	107,994,040	.....
September	157,992,487	108,703,075	.....
October	168,638,775	115,143,143	.....
November	159,217,588	117,289,735	.....
December	161,801,916	102,997,633	.....

COMPANY REPORTS

May Mining Dividends

The following is a partial list of mining dividends paid during May, 1920:

U. S. Mining and Metallurgical Companies	Situation	Per Share	Totals
American Zinc, Lead & Smelting Co., pfd	U. S.	$1.50 q.	$120,810
Anaconda Copper, c. s. z	Mont.	1.00 q.	2,331,250
Arizona Copper, com	Ariz.	9 pence	£56,996
Caledonia Mining, l. s	Idaho	0.01 m.	$26,050
Eastern Talc Co	Vt.	.05 ex.	3,484
Electric Point Mining, l	Wash.	.03 s.-a.	23,812
Golden Cycle M. & Red., g	Col.	.02 m.	30,000
Internat. Nickel, pfd	U. S.-Can.	1.50 q.	133,689
Miami Copper	Ariz.	.50 q.	373,557
Mohawk Mining, c	Mich.	1.50 q.	150,000
New Cornelia Copper	Ariz.	.25	450,000
New Jersey Zinc	U. S.	4.00 s.-a.	1,400,000
United Verde Exten., c	Ariz.	.50 q.	525,000
Canadian and Mexican Companies			
Amparo Mining, g. s	Mex.	$0.05 q.-x.	$100,000
Beaver Consolidated, s	Ont.	.03	60,000
Coniagas Mines, s	Ont.	.25 q.-x.	200,000
Granby Consol., s. l. c	Br. Col.	1.25 an.	187,500
Lucky Tiger-Combination, g	Mex.	.15	107,300
McIntyre-Porcupine, s	Ont.	.05 q.	182,014

Arizona Copper completes with this month's payment of 9d. the dividend of 1s. 6d. on its ordinary shares on which it paid 9d. in August, 1919. Eastern Talc makes its fourth dividend of 1920, previous dividends of the year amounting to 35c. per share. Resumption of dividends characterizes New Cornelia, Beaver Consolidated, and Granby Consolidated. Coniagas and Amparo declared extra dividends, besides the regular quarterly ones; and Golden Cycle announces a reduction from 3c. to 2c.

Rand Mines, Ltd., received permission to list 50,000 shares of its so-called American stock on the New York Stock Exchange.

Chino Copper Co.

Copper; New Mexico

The thirty-fourth quarterly report of the Chino Copper Co., covering the first quarter of the year 1920, shows an improvement in operating results over the last quarter of 1919. Comparative results follow:

	First Quarter 1920.	Last Quarter 1919.
Production	10,621,276 lb.	9,821,729 lb.
(a) Cost per lb. gross	14.62 c.	18.65 c.
Cost per lb. net	13.91 c.	17.68 c.
Net income from copper production	$737,605.40	$399,646.64
Distribution to stockholders	326,242.50	652,485.00
Surplus	483,484.65	
Deficit		161,858.08

(a) No allowance for Federal taxes and gold and silver recovery.

Costs of production have decreased and the deficit remaining at the end of 1919 has been converted into a surplus. Distribution of dividends amounted to 37½c. per share for the first quarter of 1920.

Utah Copper Co.

Copper; Utah

The forty-eighth quarterly report of the Utah Copper Co., covering the first quarter of 1920, shows a decrease in production coupled with a decrease in the cost of copper produced, when compared with operating results of the last quarter of 1919. A comparative table follows:

	First Quarter 1920.	Last Quarter 1919.
Production	27,257,546 lb.	27,965,470 lb.
(a) Cost per lb.	13.202 c.	16.471 c.
Net profit from copper production only	$2,291,012.91	$1,449,027.05
Disbursement to stockholders	2,436,735.00	2,436,735.00
Net surplus	433,854.86	262,720.91

(a) No allowance for Federal taxes and gold and silver recovery.

Net profits from operations in the first quarter of 1920 show a large increase over those of the last quarter of 1919. The regular quarterly disbursement of $1.50 per share was paid on March 31.

Bunker Hill & Sullivan Mining & Concentrating Co.

Silver, Lead; Idaho

The annual report of the Bunker Hill & Sullivan Mining & Concentrating Co. states that in the year 1919 dividends amounting to $1,144,500 were paid on the $3,270,000 capitalization of the company. Operating profit amounted to $1,855,547.85 from net smelter returns of $3,362,191.62. Production for the year amounted to 65,595,917 lb. of lead, sold for $3,851,469.54, an average price of .05877c. per lb., and 1,102,212.91 oz. of silver, sold for $1,242,356.24, an average price of $1.122 per oz. The total cost of this production was $3,238,277.93. Surplus account on Dec. 31, 1919, stood at $7,387,580.03.

Consolidated Interstate-Callahan Mining Co.

Lead, Zinc; Idaho

The report of the Consolidated Interstate-Callahan Mining Co. for the first quarter of 1920 states that 15,974 tons of zinc ore, lead-silver ore, and concentrates were shipped during this period, with a total net value of $591,691.22. After deducting all operating expenses and accrued income and excess profits taxes for 1920, there was a surplus of $260,109.43, out of which there was paid a quarterly dividend of 50c. per share, which amounted to $186,651.50.

Amparo Mining Co.

Silver; Mexico

During the year 1919, a total of 127,037 metric tons of ore was mined and milled, according to the annual report of the Amparo Mining Co., from which 1,249,772 oz. of silver and 33,959 oz. of gold were produced. Operating expenses were $1,462,603.38, and receipts from metals, concentrates, and slag sold amounted to $2,095,898.84, giving a gross profit of $633,295.46. Net profit, allowing for various credits and deductions, amounted to $603,945.20. Surplus on Jan. 1, 1920, amounted to $1,307,179.97. Dividends totaling $360,000.00 were paid on the $2,000,000.00 capital stock outstanding.

The Nipissing Mines Co., Ltd.

Silver, Ontario

The annual report of the Nipissing Mines Co., Ltd., states that for the year 1919 the net return on operations was the largest in the company's history. Dividends aggregating $1,800,000 were paid (1,200,000 shares, par value $5). Silver production costs of 35.61c. per oz. represented a decrease of approximately 10 per cent from 1918 costs, notwithstanding increased wages. Production in 1919 amounted to 1,905,474.93 oz. of silver, valued at $1.2077 per oz.

Shattuck Arizona Copper Co.

Lead, Copper; Arizona

The report of the Shattuck Arizona Copper Co. for the first quarter of 1920 states that 1,002,292 lb. of copper and 1,920,739 lb. of lead were produced during that period. Total earnings amounted to $445,902.66, operating expense deductions were $370,235.69, and depreciation charges totaled $19,926.93, leaving a net income, plus depletion, of $55,740.04.

Silver King Coalition Mines Co.

Silver, Lead; Utah

The annual report of the Silver King Coalition Mines Co. for the year 1919 states that net profits amounted to $66,292.29, which was carried to surplus, increasing that sum to $164,106.45. Total earnings amounted to $898,885.69.

MINING STOCKS

Week Ended May 29, 1920

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Adventure	Boston	*95	*95	*95	
Ahmeek	Boston	65	60	60	Mar. '20, $ .50
Alaska-B.C.	N. Y. Curb	1⅜	1⅛	1⅜	
Allouez	Boston	31½	31½	31½	Mar. '19, 1.00
Anaconda	N. Y.	58¼	54½	58	Feb. '20, 1.00
Ariz. Com'l.	Boston	11	9	10¾	Oct. '18, .50
Big Ledge	N. Y. Curb	⅜	¼	⅜	
Bingham Mines	Boston	10¼	8	10	Sept. '19, .25
Calumet & Ariz.	Boston	61	58	60¾	Mar. '20, 1.00
Calumet & Hecla	Boston	335	325	332	Dec. '19, 5.00
Can. Copper	N. Y. Curb	1¼	1	1⅛	
Centennial	Boston			11½	Dec. '18, 1.00
Cerro de Pasco	N. Y.	46	40½	45½	Mar. '20, 1.00
Chief Consol.	Boston Curb	3½	3½	3½	Feb. '20, .10
Chile Cop	N. Y.	16⅝	14⅜	16½	
Chino	N. Y.	33	29⅜	32½	Mar. '20, .37½
Con. Ariz	N. Y. Curb	⅛	1/16	⅛	Dec. '18, .05
Con. Copper M.	N. Y. Curb	3½	3	3½	
Cop. Range	Boston	40¾	38½	40	Mar. '20, .50
Crystal Cop. (new)	Boston Curb	*30	*25	*30	
Davis-Daly	Boston	10	8½	10	Mar. '20, .25
East Butte	Boston	13¼	12½	13	Dec. '19, .50
First Nat'l	Boston Curb	*100	*71	*95	Feb. '19, .15
Franklin	Boston	2¾	2½	2¾	
Gadsden Copper	N. Y. Curb	*75	*73	*75	
Granby Consol.	N. Y.	39⅜	37	37	May '19, 1.25
Greene-Can.	N. Y.	31	29¼	30⅜	Feb. '19, 1.50
Hancock	Boston	5½	5	5½	
Houghton	Boston Curb			*50	
Howe Sound	N. Y. Curb			3¾	Jan. '20, .05
Inspiration Con.	N. Y.	53⅜	48½	53¼	Apr. '20, 1.50
Iron Cap	Boston Curb	9½	9	9½	Feb. '19, .25
Isle Royale	Boston	2	29	30	Sept. '19, .50
Jerome Verde	N. Y. Curb			1/16	
Kennecott	N. Y.	28	25⅜	28	Mar. '20, .50
Keweenaw	Boston	1½	1½	1½	
Lake Copper	Boston	3	3	3	
La Salle	Boston			2½	
Magma Chief	N. Y. Curb	*22	*20	*22	
Magma Copper	N. Y. Curb	32	29	32	Jan. '19, .50
Majestic	Boston Curb	*20	*15	*20	
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅜	
Mass Con.	Boston	3½	3½	3¼	Nov. '17, 1.00
Mayflower-O. C.	Boston	7	5½	6⅜	Feb. '20, 1.00
Miami	N. Y.	21	18⅜	21	Feb. '20, .50
Michigan	Boston	4⅜	4⅜	4⅜	
Mohawk	Boston	65	60⅜	63	Feb. '20, 1.50
Mother Lode (new)	N. Y. Curb	6½	5⅞	6	
Nev. Con.	N. Y.	12⅞	11⅜	12⅛	Mar. '20, .25
Nev. Douglas	Boston Curb	*15	*15	*15	
New Arcadian	Boston	3	3	3	
New Baltic	Boston Curb			3	
New Cornelia	Boston	17¼	16½	17	Nov. '18, .25
Nixon Nev.	N. Y. Curb			*9	
North Butte	Boston	19	17	18½	Oct. '18, .25
North Lake	Boston	¾	¾	¾	
Ohio Copper	N. Y. Curb			3/16	
Ojibway	Boston			1½	
Old Dominion	Boston	28	25	28	Dec. '18, 1.00
Osceola	Boston	40	39	40	Mar. '20, .50
Phelps Dodge	Open Market	†195	†180		Apr. '20, 2.50
Quincy	Boston	54½	50½	54	Mar. '20, 1.00
Ray Con	N. Y.	17½	16½	17½	Mar. '20, .25
Ray Hercules	Boston Curb			*75	
St. Mary's M. L.	Boston	43	40	40½	Dec. '19, 2.00
Seneca	Boston	14¼	12½	14¼	
Shannon	Boston			1¼	Nov. '17, .25
Shattuck-Ariz	N. Y.	9½	8¼	9½	Jan. '20, .25
South Lake	Boston			2	
South Utah	Boston	*15	*14	*14	
Superior	Boston	5¼	5	5¼	Apr. '17, 1.00
Superior & Boston	Boston	4⅜	3⅜	4⅜	
Tenn. C. & C.	N. Y.	10¼	9¼	10⅛	May '18, 1.00
Tuolumne	Boston	*75	*60	*70	
United Verde Ex.	Boston Curb	*31	*29½	*31	Feb. '20, .50
Utah Con.	Boston	6¾	6⅝	6⅞	Sept. '18, .25
Utah Copper	N. Y.	71⅛	67	71	Mar. '20, 1.50
Utah M. & T.	Boston	1⅝	1½	1⅝	Dec. '17, .30
Victoria	Boston	3	2½	3	
Winona	Boston	*60	*50	*60	
Wolverine	Boston	18½	15	18½	Jan. '20, .50
LEAD					
Hecla	N. Y. Curb	4½	4 1/16	4 7/16	Mar. '20, .15
St. Joseph Lead	N. Y.	16	15½	16	Mar. '20, .50
Stewart	Boston Curb	†*18		*16	Dec. '15, .05
Utah Apex	Boston	1⅜	1⅛	1⅜	Nov. '18, .25
ZINC					
Am. Z. L. & S.	N. Y.	15½	13	14½	May '17, 1.00
Am. Z. L. & S. pf.	N. Y.	50	48	48	Feb. '20, 1.50
Butte C. & Z.	N. Y.	8¼	7½	8¼	July, '18, .50
Butte & Superior	N. Y.	23½	20	22½	Sept. '17, 1.25
Con. Interst. Cal.	N. Y.	14¾	13⅝	14⅝	Mar. '20, .50
New Jersey Z.	N. Y. Curb	205	198	204	Dec. '19, 2.00
Success	N. Y. Curb	*5	*3½	*5	July '16, .03
Yellow Pine	Los Angeles			*100	Mar. '20, .03

*Cents per share. †Bid and asked.

Stock	Exch.	High	Low	Last	Last Div.
GOLD					
Alaska Gold	N. Y.	1⅛	1⅛	1⅛	
Alaska Juneau	N. Y.	2¼	2¼	2¼	
Carson Hill	N. Y. Curb	*28½	*26	*28	
Cresson Gold	N. Y. Curb			1⅞	Mar. '20, .10
Dome Ex.	Toronto	†*21	*20	†*20	
Dome Lake	Toronto	†*8	*6¾	†*7	
Dome Mines	N. Y.	9⅝	9¼	9⅜	Apr. '20, .25
Golden Cycle	Colo. Sprgs	*92	*89	*91	Mar. '20, .03
Goldfield Con.	N. Y. Curb	*10	*8½	*10	Dec. '19, .05
Hedley	Boston			4½	June '19, .10
Hollinger Con.	Toronto	5.40	5.15	5.35	Apr. '20, .05
Homestake	N. Y.	55	55	55	Sept. '19, .50
Kewanas	N. Y. Curb			*2½	
Kerr Lake	Toronto	†4.50	4.25	4.25	Sept. '19, 1.00
Kirkland Lake	Toronto	*43	†*38	*43	
Lake Shore	Toronto	1.04	†1.00	1.04	Oct. '19, .02½
McIntyre Porcupine	Toronto	1.83	1.78	1.81	Jan. '20, .05
Porcupine Crown	Toronto	*28	*26	*27	July, '17, .03
Portland	Colo. Sprgs	*60	*58	*60	Apr. '20, .01½
Reorgan. Booth	N. Y. Curb	*6	*4	*6	
Silver Pick	N. Y. Curb	*6½	*5	*6	
Teck-Hughes	Toronto	*14	*13	*13	
Tom Reed	Los Angeles			1.60	Dec. '19, .02
United Eastern	N. Y. Curb	3½	3 1/16	3⅛	Apr. '20, .21
Vindicator Consol	Colo. Sprgs			20	Jan. '20, .01
West Dome	Toronto	*7	*6½	*7½	
White Caps Min.	N. Y. Curb	*8	*7	*7½	
Yukon Gold	Boston Curb	†1½	†1		June '18, .02½
SILVER					
Arizona Silver	Boston Curb	*80	*67	*70	Apr. '20, .03
Bailey	Toronto	*5½	*5	*5	Apr. '16, .05
Beaver Con.	Toronto	*40	*38½	*40	
Coniagas	Toronto		†2.90		Feb. '20, .12½
Crown Reserve	Toronto	*28	*25	*25	Jan. '17, .05
Kerr Lake	Boston	4	3⅜	3⅞	Sept. '19, 1.00
La Rose	Toronto	*43	*40	*40	Apr. '18, .02
McKinley-Dar.	N. Y. Curb			*50	Apr. '20, .03
Mining Corp	Toronto	1.80	†1.75	1.80	Sept. '19, 12½
Nipissing	N. Y. Curb	9¼	9	9¼	Apr. '20, .25
Ontario Silver	N. Y.			7	Jan. '19, .50
Ophir Silver	N. Y. Curb	⅛	1/16	1/16	
Peterson Lake	Toronto	*14	*13	*13½	Jan. '17, .01½
Sil. King Ariz. (new)	N. Y. Curb	*1½	*1 3/16	*1⅛	
Temiskaming	Toronto	*36	*35	*35	Jan. '20, .04
Trethewey	Toronto	*30	*30	*30	Jan. '19, .05
GOLD AND SILVER					
Atlanta	N. Y. Curb	*2	*1	*2	
Barnes-King	Butte	†1.38	†1.22	1.25	Nov. '19, .05
Bost. & Mont.	N. Y. Curb	*80	*76	*76	
Cashboy	N. Y. Curb	*8	*6½	*7	
El Salvador	N. Y. Curb	2⅝	2½	2⅝	
Goldfield Merger	N. Y. Curb	*2½	*1½	*2	
Jim Butler	N. Y. Curb	*17	*16	*17	Aug. '18, .07
Jumbo Extension	N. Y. Curb	*7	*5	*6	June '16, .05
Louisiana Con.	N. Y. Curb	3/16	1/16	1/16	
MacNamara M.	N. Y. Curb	*3/16	*1/16	*3/16	
N.Y. Hond. Rosar.	Open Market	†14½	†13½		Apr. '20, .50
Tonopah-Belmont	N. Y. Curb	1⅝	1⅜	1⅝	Jan. '20, .05
Tonopah-Divide	N. Y. Curb	1⅛	1 1/16	1 1/16	
Tonopah Ex.	N. Y. Curb	1⅞	1⅝	1⅝	Apr. '20, .05
Tonopah Mining	N. Y. Curb	1⅝	1½	1½	Oct. '19, .15
West End Con.	N. Y. Curb	1½	1 1/16	1⅛	Dec. '19, .05
SILVER-LEAD					
Caledonia	N. Y. Curb	*28	*26	*28	Apr. '20, .01
Consol. M. & S.	Toronto			26½	Apr. '20, .62½
Daly-West	Boston	4¼	4	4¼	Apr. '20, .15
Eagle & Blue Bell	Boston Curb			2 1/16	Apr. '20, .10
Electric Point	Spokane	*38	*35	*35	Dec. '19, .03
Fed. M. & S.	N. Y.	11¼	11	11¼	Jan. '09, 1.50
Fed. M. & S. pf.	N. Y.	39½	37½	37½	Mar. '20, .75
Florence Silver	Spokane	*45	*45	*45	Apr. '19, .01½
Iron Blossom	N. Y. Curb	1/16	¼	1/16	Apr. '20, .02½
Marsh Mines	N. Y. Curb	*19	*16	*18	
Prince Consol.	N. Y. Curb	7/16	⅜	7/16	Nov. '17, .02½
Rex Con.	N. Y. Curb	*9	*6	*8	
Rambler-Cariboo	Spokane	*14	*13½	*14	Feb. '19, .01
Stand. S. L.	N. Y. Curb	¼	¼	¼	Oct. '17, .05
Tamarack-Custer	Spokane	2.50	2.00	2.40	Dec. '19, .03
Wilbert	N. Y. Curb	*6½	*5	*6	Nov. '17, .10
NICKEL-COPPER					
Internat'l Nickel	N. Y.	19	16½	18½	Mar. '19, .50
Internat'l Nick. pf	N. Y.	83	83	83	May '20, q 1.50
QUICKSILVER					
New Idria	Boston			6	Jan. '19, .25
TUNGSTEN					
Mojave Tungsten	Boston Curb	*10	*5	*10	
VANADIUM					
Vanadium Corp.	N. Y.	75⅛	66	75	Apr. '20, 1.50
ASBESTOS					
Asbestos Corp.	Montreal	..	..	74	Apr. '20, 1.25
Asbestos Corp., pf.	Montreal	..	..	86	Apr. '20, 1.50
MINING, SMELTING AND REFINING					
Am. S. & R.	N. Y.	61⅜	56⅜	60⅜	Mar. '20, 1.00
Am. S. & R., pf.	N. Y.	89¼	89	89	June '20, 1.75
Am. Sm. pf., A	N. Y.	74½	74¼	74½	Apr. '20, 1.50
U. S. Sm. R. & M.	N. Y.	60¼	58	60¼	Apr. '20, 1.50
U. S. S. R. & M., pf.	Boston	44⅛	43¼	44¼	Apr. '20, .87½